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AQUACULTURE EXTENSION SERVICES REVIEW :

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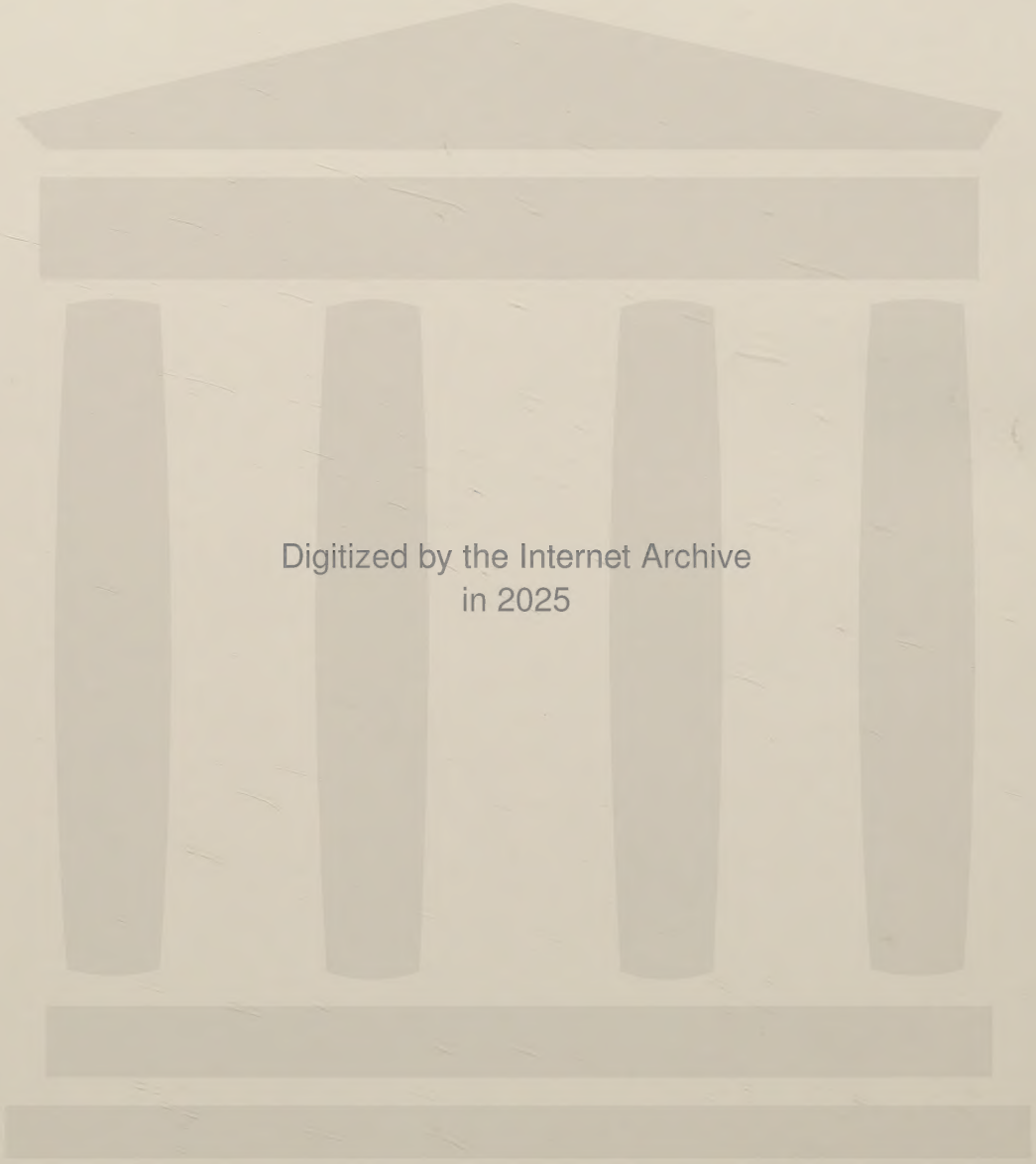

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AQUACULTURE EXTENSION SERVICES REVIEW :

INDIA

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FOOD AND AGRICULTURE ORGANIZATION OF THE UNITED NATIONS
ROME, February 1996

PREPARATION OF THIS DOCUMENT

In 1982, FAO Fisheries Circular N. 747 entitled "Aquaculture extension services review" was published. This publication gave a brief outline of the status of aquaculture extension services in 32 countries. In those early days of aquaculture development, aquaculture extension services were in their infancy, and in many countries they were not in existence.

The last decade, however, has seen dramatic development of aquaculture, especially in Asia. It is believed that the extension services played an important role in this rapid development by effectively transferring culture technologies to the producers. It is therefore important that the present status of the aquaculture extension services are reviewed, especially in the countries where aquaculture development is believed to have made some impacts on the socio-economic life of the rural people.

Bearing this in mind, this review has been prepared within the framework of the Normative Programme activities of the FAO Inland Water Resources and Aquaculture Service of the Fishery Resources Division. The original text, prepared by Mr. Dilip Kumar in New Delhi, has been edited by Mr. P.C. Choudhury in Rome.

The author gratefully acknowledges the assistance of various institutions in India for providing data/information related to the subject matter.

Kumar, D.
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ABSTRACT

India, a vast country of 3,207 million sq. km and with a coastline of 8,085 km, is unique in its physical geography, climate, land and water resources and people. The country is divided into four main physical regions viz. the great mountains of the North, the vast plains of the Indus and the Ganges, the deserts of the West and the plateau of the South.

India has a population of about 900 million of which about 40% are fish eaters. The country with its vast water resources of both inland and marine produces about 4.4 million tons of fish per year of which marine fisheries, inland fisheries an aquaculture contributions are 2.5 million tons, 1.738 tons, and 0.051 tons (1993). Exported fishery products, mainly marine and brackishwater shrimps, amount to over 200,000 tons (1993).

Fishermen constitute about 1% (about 9 million) of the population of which 3.6 million are full-time and 5.4 million are part-time. It is estimated that about 200,000 women are engaged in various activities related to fisheries.

India has great potential for the development of aquaculture both in freshwater and brackishwater areas. The country has about 2.2 million ha of freshwater ponds/tanks of which only 0.325 million ha has been developed for aquaculture; and of the 1.45 million ha of brackishwater areas only 0.9 million ha is considered suitable, but only 70,700 ha has been brought under aquaculture. The freshwater aquaculture produces (mainly carps) about 1.3 million tons against about 51,000 tons (mainly shrimp) from the brackishwater aquaculture (1993).

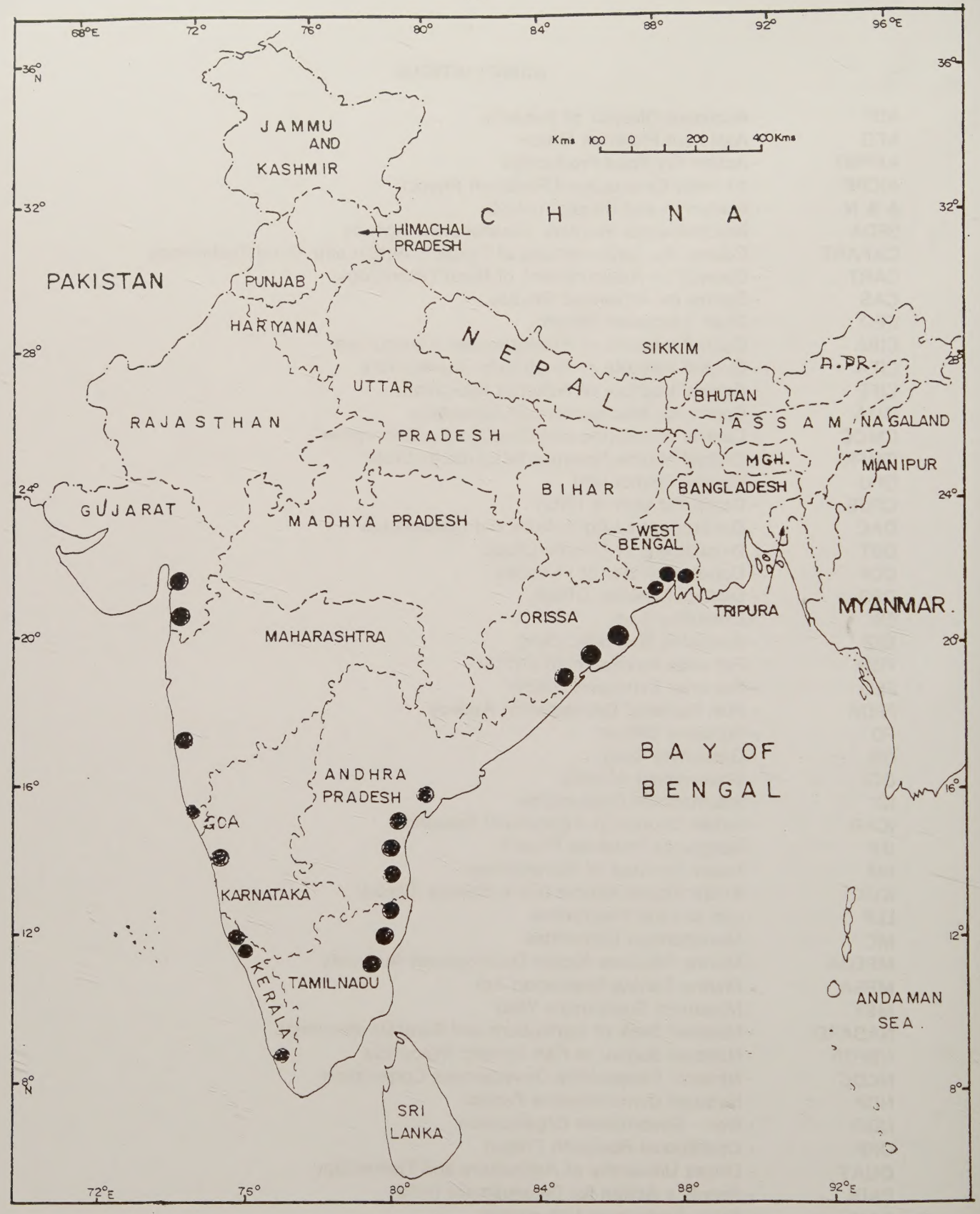
The government is assisting aquaculture development through various programmes such as FFDA, BFDA, World Bank assisted projects for freshwater and brackishwater aquaculture. ICAR is the apex institution for aquaculture research, under which the specialized institutions such as CIFA, CIBA, CIFE and various State Agricultural Universities contribute to aquaculture research and development. Aquaculture development is the responsibility of the State Governments. However, the Central Government is responsible for providing overall policy guidelines for the development of the sector. The Fisheries Division of the Department of Agriculture and Cooperation under the Ministry of Agriculture is the agency for coordinating aquaculture development in the country. Its responsibilities include planning, programming, monitoring implementation and evaluation of development programmes. At field levels, aquaculture programmes (both Central and State) are implemented by the State Fisheries Departments.

The most important centrally sponsored Agency for aquaculture extension services is the Fish Farmers Development Agency (FFDA), which is a District level organization for the development of freshwater aquaculture. To-date, 375 FFDAs have been established. They have brought 0.359 million ha of ponds/tanks under aquaculture with average production of over 2,000 kg/ha/yr. Similarly, for brackishwater aquaculture development (mainly shrimp), Brackishwater Fish Farmers Development Agency (BFDA) has been established. So far, 34 such BFDA have brought 11,000 ha under shrimp farming.

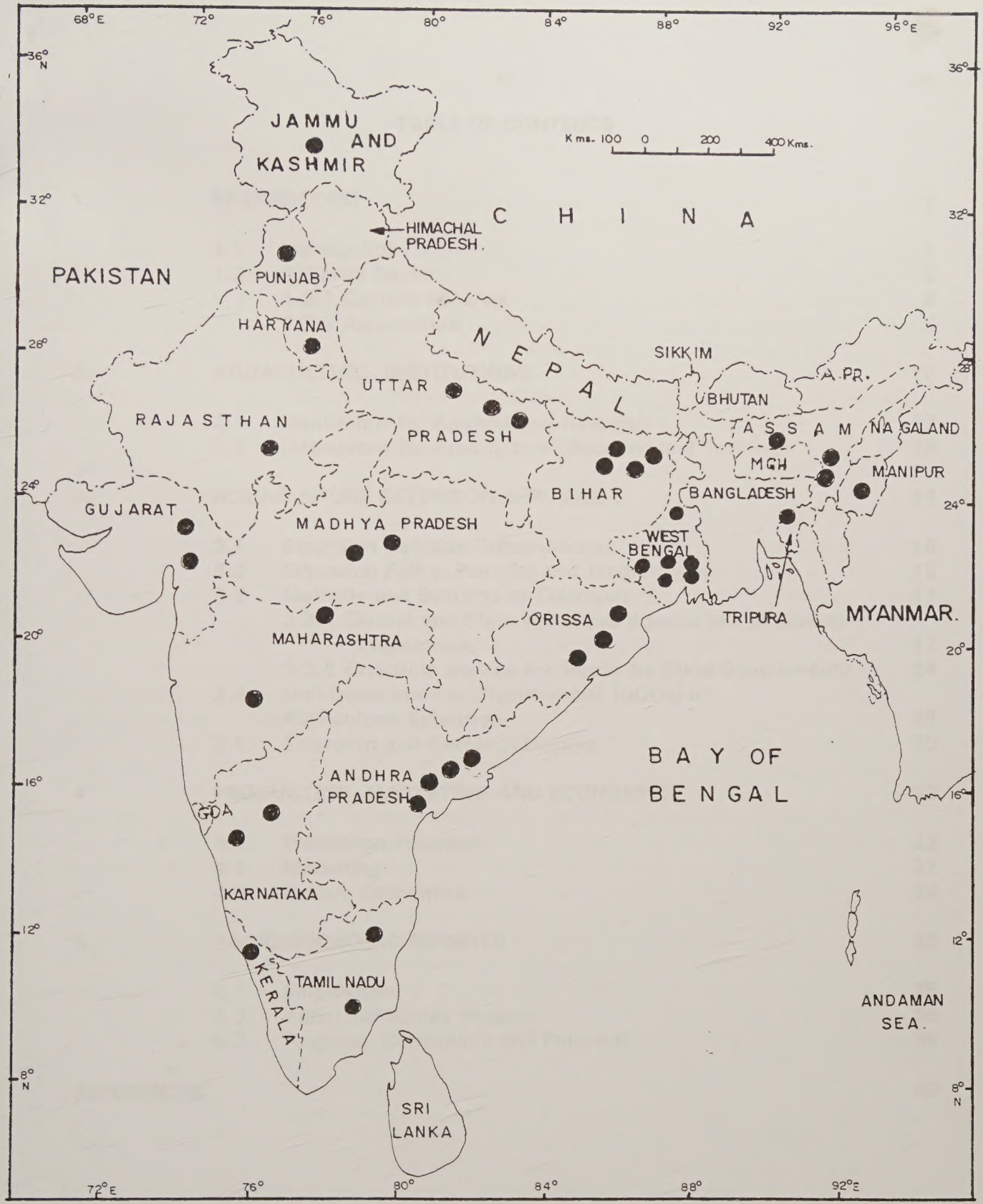
In addition, aquaculture extension services are provided by ICAR through various programmes such as Krishi Vigyan Kendra (KVK), Trainers' Training Centres (TTC), National Demonstration Programme (NDP), All India Coordinated Research Project (AICRP), Operational Research Projects (ORP), Lab to Land Programme (LLP), Marine Products Export-Development Authority (MPEDA) and Department of Bio-Technology (DBT). Also, various Non-Governmental Organizations playing an important role in providing aquaculture extension services. At the village level, rural institutions such as 351 Zila Parishad, 53,000 Panchayat Samittees and 0.22 million Gram Panchayat control the public waterbodies and lease them for aquaculture development.

ABBREVIATIONS

ADF	- Assistant Director of Fisheries
AFO	- Assistant Fisheries Officer
AFPRO	- Action For Food Production
AICRP	- All India Co-ordinated Research Project
A & N	- Andaman and Nicobar islands
BFDA	- Brackishwater Farmers' Development Agency
CAPART	- Council for Advancement of People's Action and Rural Technology
CART	- Council for Advancement of Rural Technology
CAS	- Centre for Advanced Studies.
CEO	- Chief Executive Officer
CIBA	- Central Institute of Brackishwater Aquaculture
CIFA	- Central Institute of Freshwater Aquaculture
CIFE	- Central Institute of Fisheries Education
CMA	- Centre for Management of Agriculture
CMCC	- Central Monitoring and Coordination Committee
CMFRI	- Central Marine Fisheries Research Institute
CPU	- Central Project Unit
CPUE	- Catch Per Unit of Effort
DAC	- Department of Agriculture and Cooperation
DBT	- Department of Biotechnology
DDF	- Deputy Director of Fisheries
DFO	- District Fisheries Officer
EB	- Executive Body
EEZ	- Exclusive Economic Zone
FDO	- Fisheries Development Officer
FEO	- Fisheries Extension Officer
FFDA	- Fish Farmers' Development Agency
FO	- Fisheries Officer
GB	- Governing Body
GOI	- Government of India
IC	- International Cooperation
ICAR	- Indian Council of Agricultural Research
IFP	- Integrated Fisheries Project
IIM	- Indian Institute of Management
KVK	- Krishi Vigyan Kendra (Farm Science Centre)
LLP	- Lab to Land Programme
MC	- Management Committee
MPEDA	- Marine Products Export Development Authority
MFRA	- Marine Fishing Regulation Act
MSY	- Maximum Sustainable Yield
NABARD	- National Bank of Agriculture and Rural Development
NBFGR	- National Bureau of Fish Genetic Resources
NCDC	- National Cooperative Development Corporation
NDP	- National Demonstration Project
NGO	- Non - Government Organization
ORP	- Operational Research Project
OUAT	- Orissa University of Agriculture and Technology
PADI	- People's Action for Development India
SAU	- State Agriculture Universities
SFDA	- Small Farmers' Development Agency
SMCC	- State Monitoring and Coordination Committee
SPU	- State Project Unit
SRI	- Society for Rural Industrialization
TATC	- Total Aquaculture Technology Centre
TTC	- Trainers' Training Centre
TOT	- Transfer of Technology
UT	- Union Territory



CONCENTRATION OF BRACKISHWATER SHRIMP CULTURE.



CONCENTRATION OF FRESHWATER AQUACULTURE (PONDS AND OTHER CULTURE BASED WATER BODIES)

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1. BACKGROUND

1.1 Introduction

India is unique in its physical geography, climate, land and water resources, people and their age old tradition, art and craft, culture and heritage. While northern periphery of the country is characterized by its snow clad Himalayas and other high mountain ranges, the peninsular southern part extends into the Indian Ocean between Bay of Bengal on the eastern side and Arabian Sea on the west. The country lies entirely in the tropical and sub-tropical zones of the northern hemisphere. Its main land extends between latitude 8° 4' and 37° 6' north and longitudes 68° 7' and 97° 25' east and covers an area of about 3.287 million sq. km with 15,200 km land frontier and 8085 km long coastline (Provisional as on 31 March, 1982). Besides the Indian mainland, the islands of Lakshadweep and, the Andaman and Nicobar islands are also integral part of the country. The mainland is distinctly divided into four main physical regions, the great mountains of north, the vast plains of the Ganges and the Indus, the desert region of the west and the great plateau of peninsular India. The Great plains are one of the world's greatest stretches of flat alluvium and also one of the most densely populated areas on the earth. The plains are formed by two river basins of the three important river systems, the Indus, the Ganges and the Brahmaputra. The Indus basin is drained by the Indus river and its tributaries. The Ganges basin covers the major portion of the plains and its greater part is drained by the Ganges and its tributaries rising from the Himalayas. Another set of tributaries of the Ganges consists of the Chambal, Sind, Betwa, Son and Damodar. The river Ganges in its lower reaches is joined by the Brahmaputra to form the world's largest delta before being drained into the Bay of Bengal. The major part of the Ganga-Brahmaputra delta, however, lies in Bangladesh.

The great plateau of the peninsula is flanked by the river Narmada into Malwa and the Deccan. Narmada and Tapti are the west flowing rivers, although all other major rivers of the Deccan Plateau flow into the bay of Bengal, the Godavari being the longest.

The country is also unique in its climatic variations. The southern half lies within the tropics whereas the northern part lies within the sub-tropical zone. When the northern parts have too cold a climate, the southern coastal regions enjoy a tropical climate all the year round. Yet the whole country has uniformly higher temperatures especially during summer. Certain places are well known for the heaviest rainfall in the world, the others are known for their extreme aridity. Northern India receives light winter rains. Coramandal coast of Tamil Nadu also receives winter rains due to north-eastern monsoon. The period between March and May forms the summer season.

India, a union of States, is a Sovereign, Socialist, Secular, Democratic Republic with a parliamentary system of Government. There are 25 States and 7 Union Territories and the constitution vests the legislative powers with the Parliament and State legislatures. The country has a population of 844.32 million (437.80 million males and 406.52 million females) as on 1st March 1991 which makes it the second largest populous country in the world. The literacy rate is 52%. The state of Kerala stood first with 90.59% literacy rate in the country while Bihar remained at the bottom with only 38.54%. As per 1991 census, the population in the rural area account for 76.7%. Traditionally, the population is categorized into three social groups viz. scheduled castes (15.80%), scheduled tribes (7.8%) and others. Death rate has come down from 2.74% in 1951 to an estimated

0.96% in 1990 and life expectancy has increased from 32 in 1941-51 to over 61.1 years in 1991-92. The infant mortality rate also reduced from 146 per thousand in the 50s to 80 in 1990. Diseases like malaria, tuberculosis and cholera which used to take heavy toll of life have been controlled to a great extent. The major nutritional problems still persisting are protein energy malnutrition, Vitamin A deficiency and anaemia; the most affected being the young children, pregnant and lactating mothers.

During the last 40 years (1950-51 to 1990-91), Net National Product (NNP) achieved compound growth rate of nearly 3.9% per annum. Despite adverse national and international economic environment the economy sustained the growth momentum in 1990-91 with the GDP recording 5.6% growth at factor cost over the previous year. The favourable impact of the new economic policies is expected to maintain a growth rate of 5.6% in the GDP during the Eighth Five Year Plan period (1992-97).

1.2 Fisheries Sector

Fish is the cheapest source of animal protein for about 40% fish eaters out of 56% of the non-vegetarian Indian population. The per capita availability of fish for the entire present population of about 890 million people is 5.13 kg /annum against a recommended national minimum of 11 kg/head/annum on the basis of nutritional requirement norms. However, for non-vegetarian population of about 56%, the availability is about 8.7 kg/annum; and for fish eating population of 40%, the per capita availability is 12.44 kg.

In 1991-92, fisheries together with quarrying, logging and forestry contributed 2.5% of the GDP and 3.13% to the total export earning mainly through marine products. During the same period export of marine products earned 20.25% of the total export earning by agriculture, plantation and meat products (Joseph, 1993).

During the Seventh Five Year Plan (1985-1990) and the subsequent two Annual Plans (1990-1992) and the First Year of the Eighth Five Year Plan (1992-1997) i.e., from 1985-86 to 1992-93, fish production increased from 2.876 million tons to 4.365 million tons. The average overall annual growth rate was about 7.6% during this period (Table-1 A and 1B).

Export of marine products also registered a steady growth during the same period. The quantity and value of exports increased from 86,200 tons and 3842.9 million rupees in 1984-85 to 208,600 tons and 17674.3 million rupees during 1992-93, respectively. While the quantity has more than doubled, the value in rupee terms has increased by more than 4 times (Table-2). A significant achievement in recent years on the export front is the opening up of an export market for Indian major carps and tilapia to some countries including U.S.A. Increasing quantities of value added aquaculture products are expected to be exported in the coming years.

Fishermen constitute 1% (about 9 million) of the total population of India, of which about 3.6 million (40%) are actively participating on full time or part time basis and the remaining 5.4 million (60%) are occasional fishermen. Women members of the fishing community also actively participate with their male counterpart in sorting, salting, curing of fish, collection of seed of clam, fish and shrimp from wild natural resources, maintenance of family possession of craft and gear, net mending, marketing of catch etc. It is estimated that there are over 200,000 fisherwomen engaged in such activities (Sampath, 1993; Sinha and Sampath, 1993).

Except for ponds and aquaculture farms constructed on land owned by individuals or groups, all other water bodies, such as natural depressions, canals, rivers, reservoirs, and submerged flood plains are vested with the respective State Government/Union Territories (UT) or Local Self Government (Panchayat, Municipality etc). Such water bodies are allowed to be exploited for fishery purposes through leasing or licensing by the State Govt. /UTs. In most cases, the Revenue Departments of the respective State Governments keep control of such water bodies.

The country is endowed with vast and highly diversified fisheries resources supporting a broad spectrum of aquatic flora and fauna. Fish itself is represented by over 2,500 species. Some of the native fish/shrimp species are well known for their culture potential world over. Indian major carps viz., catla (*Catla catla*), rohu (*Labeo rohita*), mrigal (*Cirrhinus mrigala*), catfish (*Clarias batrachus*), several shrimp species such as *Penaeus monodon, P. indicus, P. merguiensis* and freshwater prawn, *Macrobrachium rosenbergii,* are well recognized throughout Asia for their farming potential.

Fish farmers, artisanal fishermen and fisherwomen engaged in fish culture, collection of fish seed from natural resources, fishing in closed and open inland and coastal waters, processing, transport and marketing of the fishery products etc., are the primary producers of the sector and as such they are the focal object for sectoral development and welfare schemes. Unlike agriculture, there is marked socio-economic and functional stratification among the primary producers. Broadly, they are divided into small scale aquaculturists belonging to landless/pondless marginal farmer category; the artisanal fishermen and fisherwomen engaged in fishing, transport, crude processing and retail marketing of fishery products; and the last group consisting of affluent and well-off aquaculture entrepreneurs, corporate bodies, trading houses etc. engaged in operating large commercial farms, mechanized and sophisticated fishing crafts, processing plants, and business related to wholesale marketing and export.

As per the Constitution of India, fisheries is primarily a State subject. The Central Government has the direct responsibility for development of fisheries only beyond the territorial waters. However, by virtue of constitutional provision, the Central Government through the Fisheries Division of the Ministry of Agriculture plays a key role in the growth and development of fisheries through implementation of a number of Central and Centrally Sponsored Schemes and through overall coordination of fisheries development programmes and policies (Joseph, 1993).

1.2.1 Capture fisheries

Marine

The marine fisheries resources lie along a 8085 km coastline with a continental shelf area of about 512,000 sq. km and 2.20 million sq. km of the Indian Exclusive Economic Zone (EEZ). Against the estimated potential of about 3.92 million tons of fish from the Indian EEZ (2.2 million from the 50 m depth and the remaining from beyond 50 m depth area), the present level of exploitation is in the order of 2.57 million tons which is about 65 % of the total exploitable potential (Table- 3).

About 80% of the present level of marine fish production is accounted for from 50 m depth zone and the remaining 20% from depth upto 200 m. While 98% of this production is contributed by the traditional and mechanized sector, the remaining 2% is contributed

by deep sea fishing sector. About 56% of the total marine fish production is contributed by pelagic species and 44% by demersal. The contribution of the west coast to the total marine fish production is 70% and the remaining 30% come from the east coast. It is opined that little scope exists for increasing production from inshore waters and hence efforts should be directed towards the underexploited and unexploited resources in the offshore areas(James, 1993).

Inland

The total exploitable fishery potential of the inland resources is estimated to be around 4.5 million tons, including aquaculture (Table-3). The production from inland capture fisheries during 1992-93 was of the order of 0.49 million tons against the estimated potential of about 1.59 million tons. There has been a steady growth in fish production from inland fisheries (Table-1A).

Riverine fisheries

Riverine subsystem of the inland capture fisheries consists of five river systems viz. the Ganga river system, the east coast river system comprising the east flowing rivers, the west coast river system flowing westwardly and joining the sea in the west coast, the Brahmaputra river system of the north eastern region, and the Indus river system of the north .

These river systems are rich in fish fauna, each with its own particular characteristics and location. Major carps do not form a substantial catch except in the rivers Ganga, Brahmaputra, Godavari and Krishna. Seine nets, gill nets, hook and line and various types of traps are used for fishing in rivers. Due to the highly dispersed nature of fishing and landing centres, diversity of under-utilized fishing gears, high percentage of subsistence fishing, migratory nature of fishing community etc., authentic base line data on the fish catch from the riverine system is scanty. The fisheries potential varies from stretch to stretch and from river to river. In some selected stretches of the Ganges, Brahmaputra, Godavari and Krishna, the yield is reported to vary between 0.64 and 1.6 ton / km / annum (Parameswaran, 1993). A sample study conducted by Indian Institute of Management (IIM), Ahmedabad, indicated a production potential of about 1 ton / km /yr. of the riverine systems and the number of persons engaged in fishing / km of length of river varying between 3 to 26. However, the then Central Inland Fisheries Research Institute (CIFRI) indicated that the total catch of commercially important species of carp and catfish have significantly declined. A marked decline was also noticed in catch per unit of effort(CPUE) and average size of the catch. Jhingran (1989) and Jhingran and Sugunan (1989) have described the details of environmental impacts on riverine fisheries and suggested suitable management measures. Irrational use of fishing gears, deterioration of water quality, loss of breeding grounds and large scale exploitation of broodstock and juveniles have been outlined as potential factors for depleting riverine fisheries resources. A typical example being the depletion of mahseer and hilsa stock in the Ganges river systems, where they are already under threat of extinction in the middle and upper reaches of the river.

Despite the development of induced breeding and hatchery technologies, riverine systems are still the important source of major carp seed. However, the availability is influenced by several hydrological and meteorological factors and as such it is difficult to give an estimate of reliable seed production potential. In recent years, industrialization, urbanization, creation of man made impoundments for irrigation and hydroelectric power

generation, flood control, drainage, increased silt load due to afforestation etc., have led to large scale destruction of breeding grounds of fish.

Reservoir fishery

Incidental to major development activities in the field of agriculture, irrigation and power sector, over 975 large and medium size reservoirs have been constructed in the country. It has been estimated that about 3 million hectares of water area are available in the form of reservoirs (Anon, 1976). Subsequent studies conducted by IIM , Ahmedabad, indicated that the total water area available for fisheries development in the reservoirs is about 1.45 million ha. However, by the turn of this century it is expected that the total area of reservoir would reach 3 million ha mark. Based on size, the reservoirs in India are classified into large (above 5000 ha), medium (between 1000 and 5000 ha) and small (below 1000 ha). About 92% of water area is covered by small and medium size reservoirs. The reservoirs are estimated to have fish production potential varying from 50 to 300 kg/h/yr. depending upon the size, nutrient status and geographical locations. The present average yield is very low, about 15.0 kg/ha/yr. (Jhingran, 1991; Parameswaran,1993). Jhingran and Tripathi (1978) have presented a comprehensive review of the various steps which have been adopted for development of fisheries of the Indian reservoirs. Research efforts by CIFRI/CICFRI, have led to sound technological approaches that can substantially increase the production level. Production ranging from 100 to 202 kg/ha/yr. has already been achieved in some of the small reservoirs which are also suitable for integrating other farming systems such as agriculture, horticulture, livestock etc., to develop self sustaining villages (Jhingran, 1986; Parameswaran,1993). However, this could be achieved only in a few reservoirs, most of the reservoirs are yet to be brought under proper management for fisheries development.

Roughly around 2 million people are engaged in reservoir fisheries during the peak fishing season which falls during summer months. Fishing is usually done by non -motorised country boats except in a few reservoirs where motorised boats have been introduced recently. Gill nets, drag nets and cast nets are the gears widely used.

It is estimated that the total annual production from reservoirs is between 40,000 and 50,000 tons. However, through adequate stocking, conservation, management and regulation measures it is possible to increase the average annual production rate up to about 50-100 kg/ha/yr. The small reservoirs have the potential to yield even more than 100 kg/ha/yr. By adopting good management practices, developing necessary infra-structure and providing a conducive socio-economic environment it is possible to achieve an annual production level of at least 0.161 million tons from reservoirs.

The fishing rights of most of the reservoirs are vested with the State Fisheries Departments and the leasing system transfers the fishing rights to fishermen. The leasing system vary from state to state and also from reservoir to reservoir. The main objectives are to generate revenue, ensure conservation, and also to bring improvement in the quality of life of the fishing community. The type of leasing system depends upon the production, size of the reservoir, communication facilities, scope of marketing and the number of fishermen and their socio-economic background. Some of the States have given certain reservoirs to public bodies like Corporations and Cooperatives for management and exploitation. In some States like Bihar and Rajsthan the fishing rights are given by public auction to the highest bidder with a preference to fisheries co-operatives.

Wetland Fisheries

Wetlands in the form of oxbow lakes/beels are shallow nutrient rich water bodies and are formed due to changes in the river courses. These occupy significant position among the culture based capture fisheries in terms of magnitude as well as production potential. In the eastern and north-eastern states there are over 0.2 million ha. of oxbow lakes producing between 120 to 320 kg/ha/yr, although these beels are capable of yielding between 1 to 1.5 ton/ha/yr under suitable management measures. The fisheries of the beels are generally dominated by miscellaneous species followed by major carps, catfishes and murrels.

1.2.2 Aquaculture

India has vast and varied potential for aquaculture development both in the freshwater and brackishwater areas. The available statistics indicate that there are about 2.21 million ha of water areas in the form of freshwater tanks and ponds and about 1.41 million ha of brackishwater areas in different forms of ecosystems.

Freshwater Aquaculture

Freshwater Aquaculture is practised in ponds and tanks. Except for those ponds which have been recently constructed for scientific fish culture, all the ponds are of undrainable nature and predominantly rain fed. Due to several factors such as physical nature of the bottom soil, percolation, seepage, evaporation, fluctuation in ground water table, rainfall distribution through different seasons etc., the water level in these ponds fluctuate considerably. These ponds usually have high ground water table and bottom soil with high water retention capacity. However, considerable fall in water level is recorded during summer. Most of the ponds are built for multipurpose community use such as irrigation, bathing, washing, cooking, drinking and also for fish culture. Some of the fish culture management practices such as stocking density, stocking and cropping time etc., are thus adjusted according to volume of water available through the seasons of the year. Fish farming in undrainable multipurpose pond is an age old traditional practice in India. Fry or fingerlings of the three Indian major carps, surface feeder catla (*Catla catla*) column feeder rohu (*Labeo rohita*) and bottom feeder mrigal (*Cirrhinus mrigala*) are stocked in ponds in June/July or as soon as the seed are available and marketable fish are harvested in March/April in the subsequent year when the water level recedes in the pond. Except for some areas in West Bengal where irregular application of manure and feed are followed such inputs are sparingly used in other parts of the country. However, with the perfection of the technology of composite fish culture during 1970s and its introduction to the field, aquaculture in small tanks and ponds has picked up momentum in recent past. Where the seed of Chinese carps [silver carp (*Hypophthalmychthis molitrix*) and grass carp (*Ctenopharyngodon idella*)] and common carp (*Cyprinus carpio*) are available, they are also stocked along with Indian major carps with regular manuring and feeding. The introduction of the technology of composite fish culture has increased farmers production and net profit; and as a result the traditional practice is gradually being replaced by composite fish culture (Kumar, 1992). This technology has also influenced the utilization pattern of available water area. Most significant impact has been seen in Andhra Pradesh, where about 75,000 ha of low lying areas and paddy fields have been converted into well designed fish ponds and being used for scientific fish culture (Shetty and Verghese, 1993).

Quick growth of freshwater aquaculture has also created positive impact on ancillary industries such as packaging, cold storage and ice plants, transport by insulated vans etc., thereby the sector has generated additional employment opportunities. Provision of support services and extension through the organization of Fish Farmers' Development Agencies (FFDA) has created immense impacts. According to a recent estimate, out of 2.21 million ha of tanks and village ponds about 0.325 million ha of water area has been developed and brought under scientific fish culture. The culture fisheries now contribute 1.3 million tons to inland fish production of 1.79 million tons. These recent observations confirm that the bulk of inland fish production now is contributed by culture and culture based capture fisheries in tanks/ponds and medium and small reservoirs (Chauhan, 1993). A central government sponsored scheme for the development of freshwater aquaculture was introduced as a pilot project in a few selected districts in 1975 through the establishment of Fish Farmers' Development Agencies (FFDAs). So far, 397 FFDAs have been sanctioned by the Government of India covering major potential Districts in all the States and Union Territory (UT) of Pondicherry. Due to the efforts of FFDAs, productivity in ponds and tanks has gone up to 2075/kg/ha/yr during 1992-93 against that of only 50 kg/ha/yr prior to the introduction of FFDA concept of aquaculture development during 1974-75 and only 900 kg/ha/yr in 1984-85. These FFDAs have so far brought under scientific fish farming over 0.36 million ha water area and have imparted training to 0.4 million fish farmers. Consequent to fast development of aquaculture through popularization of scientific fish farming, demand for quality fish seed have shown a sharp increase. Keeping this in view, the Government has also created the requisite infrastructure facilities for breeding and propagation of commercially important Asiatic carp species. The Government has constructed 47 commercial fish seed farms and hatcheries under both the National Programme for Fish Seed Development and the just concluded Inland Fisheries Project with World Bank assistance. In addition, a number of private entrepreneurs, particularly in West Bengal and Andhra Pradesh, have ventured into fish seed production through establishing over 210 carp hatcheries. All these infrastructural developments have created significant impact on fish seed production. The fish seed (fry) production has reached the 12,500 million mark in 1992-93 against the production of 5,639 million fry in 1984-85 (Table-4).

Brackishwater Aquaculture

The culture of brackishwater shrimp and fish, until recently, has been oriented towards extensive farming in the coastal paddy fields of Kerala and West Bengal through the traditional method popularly known as "Trapping-cum-holding method". Through this method, farmers allow entry of juveniles of fish and shrimp in the submerged paddy fields during the high tide and keep them trapped for several months to allow them to grow to marketable size. No selective stocking and stocking density are followed; neither feed is applied . Although milk fish (*Chanos chanos*), mullet (*Mugil spp.*), pearl spot (*Etroplus suratensis*) and to some extent sea bass (*Lates calcarifer*) have been found to offer a good potential for brackishwater fish culture, so far they have not been adequately popularized.

Collection of seed from the natural habitats remain the principal source of brackishwater fish seed which are abundant along the east coast. The relatively longer growing time (six to nine months), lower price etc. are the main constraints to the development of fish culture in brackishwaters. Among the shrimp, the tiger prawn (*Penaeus monodon*) is the most widely accepted shrimp species for culture in West Bengal, Orissa and Andhra Pradesh. India has a good source of natural seed resource of the species in the brackishwater regime of the rivers which are exploited by the traditional bheri system (CIFRI, 1985; Alagarswamy, 1991). The white prawn (P. *indicus*) is cultured in the

traditional pokkali (a variety of paddy) fields of Kerala and kharlands of Karnataka and Goa and under the scientific extensive and semi-intensive systems in Andhra Pradesh and Tamil Nadu (Alagarswamy, 1991). The traditional system of bheries of West Bengal, pokkali and perennial fields of Kerala and gaganies of Karnataka and Goa are tide-fed ponds dependent on auto-stocking by tide-borne seed and are harvested periodically. These cover a total area of about 50,000 ha. In West Bengal, the average production has been estimated at 775 kg/ha/yr with a P. *monodon* component of 18% (CIFRI-1986). In Kerala, the productivity is about 700 kg/ha/yr with *P. indicus* 36 to 43%, *P. monodon* 0.7 to 1.0%, *Metapenaeus dobsoni* 53 to 57 % and *M. monoceros* 3.5 to 6.0%. In Orissa, the average yield is 633 kg/ha/yr. with *P.monodon* constituting 19.43% (Mohanty, 1988). In Karnataka, the production is low at 339 kg/ha/yr with shrimp component of 86.58% (Srivastava *et.al* 1985).

The total (brackishwater and estuarine) potential area has been estimated at 1.456 million ha of which about 0.902 million ha have been considered suitable for aquaculture (Srivastava *et.al* 1985). More recent estimates by MPEDA are presented in Table-5. The recent micro level survey conducted by Central Institute of Coastal Engineering for Fishery, Bangalore, has however revealed that at least 2 25,000 ha could be brought under extensive and semi-intensive fish/shrimp farming in the near future (Sampath, 1993). Almost half of this potential area is already mapped through satellite imagery and the remaining part is expected to be completed very soon by Indian Space Research Organization (ISRO). Presently, about 70,700 ha area is under extensive, semi-intensive and intensive shrimp farming (Table 6). Out of this, about 52,500 is under traditional and extensive and 14,000 ha under semi-intensive farming. Considering the immense production and export potential of brackishwater aquaculture the Government is implementing a scheme for "Integrated Brackishwater Fish Farm Development". About 32 schemes for shrimp farming covering over 2,000 ha for the development through State Governments have been introduced with focus on small and marginal fish farmers. In addition, 34 Brackishwater Fish Farmers' Development Agencies (BFDA) in all the maritime States and A & N Islands have been sanctioned following the pattern of FFDA. So far, about 11,500 ha of brackishwater area has been developed for shrimp farming (Sampath, 1993). To cope with the growing demand for shrimp seed, 6 shrimp hatcheries with a designed capacity for producing 120 million PL 20/annum, have been established. Also, the Government of India, with UNDP assistance, has established 4 pilot shrimp farms and 1 pilot shrimp hatchery.

The Marine Products Exports Development Authority (MPEDA) is also playing a catalytic role in promoting brackishwater shrimp farming in the country as part of its export promotion programme. Large shrimp hatcheries with projected capacity of 110 million seed have already been established by MPEDA in Orissa and Andhra Pradesh and a few others are in the pipeline. Over 20 shrimp hatcheries have already been established under the public and private sectors and a few others have been proposed (Table-7). Private enterprises and corporate houses are entering prawn farming in a big way in some of the States especially in Andhra Pradesh, Tamil Nadu and Maharashtra, some of them with foreign collaboration.

However, most of the existing hatcheries are yet to deliver optimum output. This has put too much pressure on the natural shrimp seed resources with far reaching implications. Alagarswamy (1989) reported that for every *P.monodon* post-larva collected from nature, nearly 18 post-larvae of other shrimp and several fish species are being sacrificed. In West Bengal alone, the total harvest of wild shrimp seed is around 400 million every year

resulting in the destruction of nearly 7 billion fry/juveniles of other species. Similarly, the natural shrimp seed grounds of Orissa and Andhra Pradesh are also being exploited to meet the fast growing demand.

MPEDA has fixed an export target of over Rs. 3,000 crore worth of marine products by the end of the Eighth Plan period, 80% of which is to be contributed by shrimp. Out of the total estimated potential of about 8.4 million tons of fish per annum from marine and inland resources, only about 50 % has been exploited. In the marine fisheries subsector, 65% of the total exploitable potential is already exploited leaving hardly 35% for further exploitation. Whereas in the inland fisheries, the potential available for exploitation is over 60%, thus offering more scope for implementation of a number of development oriented programmes in this sector, particularly through aquaculture. There is great scope for the expansion of aquaculture both in the freshwater and brackishwater. Out of over 3.6 million ha of culturable water area in the form of freshwater tanks and ponds and brackishwater areas, only about 0.7 million ha is currently under aquaculture. Efforts to bring about at least 1/3rd of the available potential areas under aquaculture could result in doubling aquaculture production by 2000 AD and as such aquaculture deserves greater emphasis for development.

Major Development Constraints

Some of the major constraints hampering the aquaculture development programmes have been highlighted time and again by a number of fisheries planners, administrators, and scientists in a number of fora. The most common constraints are outlined here:

Freshwater Aquaculture

- Non-availability of quality fish seed was considered to be one of the most critical constraints since the popularization of composite fish culture in the seventies. Due to the establishment of a large number of carp hatcheries, the pressure on seed demand has eased to a considerable extent. However, the suppply of fingerlings of appropriate stocking size is still far from satisfactory.

- Freshwater aquaculture has virtually become synonymous with carp culture. Due to the stagnation of price for carps in the domestic market, the farmers are seriously looking for alternative species and farming practices such as catfish culture, murrel culture, freshwater prawn culture etc. Although several research institutes have claimed and highlighted the promise and potential of several culture technologies, hardly any significant impact has been noticed. The most important limitation was found to be the non availability of seed of the candidate species. Seed of catfishes, murrels, freshwater prawn etc., are available only from natural sources as the technologies are yet to be perfected for commercial scale production.

- Inspite of the availability of suitable aquaculture technologies with high production and profit potential, only about 15% of the available water area is under scientific fish culture. Most of the public water bodies remain unutilized or underutilized due to the absence of an uniform long term leasing policy.

- A cost effective practical feed using locally available feed ingredients is yet to be developed and made available at commercial scale.

- Lack of extension support at the grass root level is clearly felt. Inspite of the fact that fish farming has become popular throughout the country with the establishment of FFDAs which has helped the farmers by providing support services through its inbuilt design, the extension component is still critically weak in the system.

- Extremely slow rate of institutional credit /subsidy support to small and marginal farmers due to cumbersome and procedural complexities.

- Poor infrastructure facilities for domestic fish marketing.

- Slow pace of development of intensive aquaculture technology.

The technology of composite fish culture which was developed in early seventies could demonstrate production over 10 tons/ha/yr. However, even after 20 years, there is hardly any intensive aquaculture technology available in the country. Recently, the Central Institute of Freshwater Aquaculture (CIFA) under support from the Department of Biotechnology (DBT) has come forward with an improved freshwater aquaculture technology with a potential for producing fish over 15 ton/ha/yr (George John, personal communication). However, it is still under experimental stage and requires standardization and perfection through pilot scale field trials.

Brackishwater aquaculture

- Inadequacy of the indigenous technologies for the commercial semi-intensive shrimp farming, shrimp seed production and the production of cost effective pelleted feed for shrimp is widely felt.

- Absence of suitable and uniform land leasing policy for shrimp farming and the procedural delays in processing applications by the state governments discourage the potential aquaculturists.

- Inadequacy of trained technical staff for implementation of the brackishwater aquaculture programmes in states.

- Lack of proper extension machinery, extension orientation and extension skill in the state fisheries departments. The fisheries officers and staff are basically tuned to function as fisheries administrators and as such hardly any inclination is seen towards providing extension services.

- Limited availability of indigenous equipment and appliances required for semi-intensive and intensive shrimp farming and shrimp hatchery system.

- Limited availability of hatchery produced shrimp seed for culture is also a major constraint and hence over dependence on natural collection. Increased intensity of efforts for natural collection has also resulted in large scale sacrifice of seed of other species of fish and shrimp.

- Non-availability of suitable larval feed and technology for artificial propagation of commercial shrimp species.

. Non-availability of suitable technology for brood stock management and paucity of berried females from natural habitats.

Ongoing Development Activities

Development of freshwater Aquaculture

Popularization of composite fish culture in ponds and tanks has been initiated by the scheme of FFDA. A total of 397 FFDAs have been sanctioned by the Department of Agriculture & Cooperation, Government of India, to cover the major potential Districts in all the States and Union Territories of Pondicherry (Table-8).

Fish seed Development

At present, there are over 400 carp hatcheries under operation in the Government and private sector. Under National Fish Seed Production Programme there are 46 modern fish seed hatcheries having a designed capacity to produce about 1046 million fry per annum. This also includes 18 hatcheries constructed under the World Bank aided Inland Fisheries Project in the States of Bihar , Madhya Pradesh, Orissa, Uttar Pradesh and West Bengal. The National Fish Seed Programme has now been transferred to the State Governments. During the Eighth Five Year Plan, the Centrally Sponsored Schemes for the development of aquaculture have components under which subsidy up to Rs. 50,000 can be granted to any individual or group for establishing hatcheries.

Strengthening of Infrastructure for Inland Fish Marketing

This central government scheme is expected to provide remunerative price to fish farmers for their products and making available fresh fish at reasonable price to the consumers. Under the scheme, assistance is provided to the State Governments for strengthening marketing infrastructure facilities of their fisheries corporations, fisheries marketing organizations and fisheries cooperatives. The scheme encourages establishment of cold storage, ice plants, fish handling sheds, retail marketing outlets etc., besides providing insulated trucks for transportation of fish and bicycles with insulated boxes for facilitating retail trade. Already 5 large units and 13 small units have been sanctioned to 15 States. After assessing the impacts and economic viability of these units, the future of the programme would be decided. An amount of Rs. 250 million has been earmarked for the scheme.

Brackishwater Aquaculture Development

Due to inadequacy of indigenous shrimp culture technologies, lack of experience in proper site selection and farm management, the programme for brackishwater aquaculture development failed to yield desired results. Realising this and learning from the past experience, upgradation of shrimp culture technology was given priority during the 7th Plan under a new name "Integrated Brackishwater Fish Farm Development". An UNDP assisted Coastal Aquaculture Project was also implemented. The 7th Plan also included the establishment of Brackishwater Fish Farmers' Development Agencies (BFDA), strengthening of the technical wing in State Fisheries Directorates and establishment of brackishwater shrimp culture demonstration farms and hatcheries by providing technology packages and financial and extension support services. So far, 34 BFDAs have been

sanctioned in the maritime states and in the A&N Islands and the progress made by these agencies are summarized in Table-10.

By the end of 1992-93 about 10,000 ha of brackishwater area has been brought under shrimp culture by the BFDA. An allocation of 280 million rupees has been made for the development of brackishwater aquaculture in the country. It is expected that about 10,000 ha of additional brackishwater area could be brought under shrimp farming, 7000 ha under extensive and the remaining 3000 ha under semi-intensive farming during the 8th Five Year Plan period. Details about subsidy provision has been incorporated in the subsequent section and in Tables 11 and 13.

External Aided Project - World Bank Assisted Shrimp and Fish Culture Project

The project has been under implementation from the financial year 1992-93 for a period of 7 years. The main objective of the project is socio-economic development of the fishing community including women members of their family. The project is presently under implementation in West Bengal, Orissa and Andhra Pradesh with fish and shrimp culture development while with only fish culture component in Bihar, U.P. and M.P. The project cost is approximately 95 million US$. The project will also involve the development of Ox-bow lakes and reservoirs (Anon-1993).

2. AQUACULTURE INSTITUTIONS

2.1 Institutions for Aquacultural Research

ICAR is responsible for conducting and coordinating fisheries research, education and training in the country through its resource specific research institutes, universities and fisheries colleges under State Agricultural Universities (Dehadrai, 1993).

Central Institute of Freshwater Aquaculture (CIFA), Bhubaneswar

The Institute conducts research and training on the culture of Indian and exotic carps, catfishes, freshwater prawns, molluscs, frog and other freshwater organisms. Other related aspects such as integrated farming systems, weed control and utilization, aquaculture engineering, productivity and environmental dynamics, ichthyopathology and fish health management, breeding and reproductive physiology, fish nutritional physiology and fish feed technology, aquatic microbiology, Aquaculture economics and statistics etc., are also the major areas of activity. The Institute also conducts M.Sc. and Ph.D. courses in collaboration with Fisheries College under Orissa University of Agriculture and Technology (OUAT), Bhubaneswar. Its resource based Divisions - Peninsular Aquaculture Division, Freshwater Prawn Breeding Division, Sewage Fed Aquaculture Division are located elsewhere in the country to carry out research in their respective fields. A Training Centre - Krishi Vigyan Kendra (Farm Science Centre) and Trainer's Training Centre is also attached to the Institute to impart training in various aquaculture practices to the farmers and extension personnel.

Central Institute of Brackishwater Aquaculture (CIBA), Madras

The Institute was established in 1986 to provide R&D support to brackishwater aquaculture in the country. The Institute (headquarters) is located in Madras with the field

laboratories and the farm at Muttukadu; and Research Centres at Kakdwip in West Bengal, Puri in Orissa and Narakkal in Kerala . Conducting research for the development of economically viable system of culture technologies of fish and shell fish in brackishwater areas to increase production and productivity is the major activity of the Institute. Besides, the Institute makes the assessment of brackishwater aquaculture potential taking into account the ecological and environmental quality aspects and also acts as nodal agency for providing scientific information and transfer of technology for the development of brackishwater aquaculture in the country.

Central Marine Fisheries Research Institute (CMFRI), Cochin

The Institute is the centre for all research activities related to marine capture fisheries. However, it now has programmes for research and development of sea-farming technologies.

2.2 Institutions for Aquaculture Education and Training

Central Institute of Fisheries Education (CIFE), Bombay

The Institute has now assumed the status of an university (Fisheries) and considered to be the nodal agency for fisheries education and training in India. Development of trained and skilled manpower to manage State Fisheries Departments, aquaculture, fishing and processing industries, fisheries credit institutions etc. is the main objective of the Institute. It offers two year Master Degree Programme on fisheries and aquaculture management, and a limited number of specialized Ph,D. programmes for candidates from both India and abroad. The Institute also offers two year Post-graduate Diploma course in fishery science which aims at giving a thorough knowledge of aquaculture, fishing and fish processing industry for district level techno-administrators. Research and several need based short term training programmes are also often conducted on fish culture and fish and prawn seed production. Apart from the headquarters, it has an Operational Research Project (ORP), three regional training centres and three aquaculture training farms located in different parts of the country. The Post-graduate and Ph.D. courses have dissertation programme which delivers considerable time bound research outputs. In addition to the CIFE, the Fisheries Colleges under various Agricultural Universities also conduct regular aquaculture courses at Bachelor's and Master's degree levels. Dehadrai (1992) enlisted the institutions and their ongoing fisheries education programme as described here:

. College of Fisheries, University of Agricultural Sciences, Mangalore, Karnataka

Conducts regular courses for Bachelor's and Master's degree in fisheries covering all the major aspects including freshwater aquaculture. Research is also conducted at the College under dissertation programme.

. College of Fisheries, Assam Agriculture University, Jorhat, Assam

Conducts regular courses at Bachelor's degree level with major emphasis on inland fisheries including freshwater aquaculture.

. College of Fisheries, Kerala Agricultural University, Kochi, Kerala

Conducts regular courses on various aspects of inland and coastal fisheries including freshwater and brackishwater aquaculture at Bachelor's and Master's levels and research on related fields.

. College of Fisheries, Rajendra Agriculture University, Dholi, Bihar

Conducts courses at Bachelor's degree level in fisheries including freshwater aquaculture.

. College of Fisheries, Konkan Krishi Vidyapeeth, Ratnagiri, Maharashtra

Conducts Bachelor's and Master's degree courses in fisheries covering both fresh and brackishwater aquaculture.

. College of Fisheries, Orissa University of Agriculture and Technology, Rangailunda, Orissa

Bachelor's and Master's degree courses are conducted in fisheries covering aquaculture and related aspects. Research activities have also been taken up under the Ph.D. programme in association with CIFA, Bhubaneswar.

. Punjab Agricultural University, Ludhiana, Punjab

Vocational courses in fisheries and short courses in fish culture are conducted at the Department of Zoology.

. Fisheries College, Tamil Nadu-Veterinary and Animal Sciences University, Tuticorin, Tamil Nadu

Bachelor's, Master's and Doctorate level programmes are conducted covering all the major aspects of inland and coastal fisheries and aquaculture.

. College of Fisheries, G.B. Pant University of Agriculture and Technology, Pant Nagar, U.P.

Bachelor's level programmes are conducted in fisheries covering different aspects of capture and culture fisheries.

. Gujarat Fisheries & Aquatic Sciences Research Institute, Okha-Port, Gujarat

Short courses on different aspects of aquaculture including hatchery management of prawn are conducted.

. Indian Institute of Technology, Kharagpur, West Bengal

Master's and Doctorate level programmes are conducted in the field of aquaculture engineering.

In addition to the enlisted fisheries colleges under agricultural universities of the country, a number of other Universities/Colleges also extend facilities for aquaculture oriented degrees with research opportunities under the Department of Zoology or Life Sciences.

3. AQUACULTURE EXTENSION SERVICES

3.1 Extension Services Organizations

As already referred, fisheries is primarily a state subject as per the constitution of India and as such the States have the responsibility for the development of fisheries within their respective territory, whereas the Central Government has the responsibility for the development of fisheries only beyond the territorial waters of India. However, by virtue of constitutional provisions, the Central Government plays a key role in promoting growth of the sector through implementation of a number of Central and Centrally sponsored development schemes and provides policy guidance for overall fisheries development in the country.

Central level extension services support

The Fisheries Division in the Department of Agriculture and Cooperation under the Ministry of Agriculture is the nodal agency for coordinating fisheries development programmes in the country and giving major policy guidelines to the States. As such it performs multifaceted role which includes, planning, programme development, monitoring implementation and evaluation of ongoing programmes, drafting policy guidelines, monitoring the performance of fisheries institutions directly under the control of the Ministry etc. Besides, they also take up extension activities to some extent. By virtue of their access and proximity to national electronic mass media and printed media they have been able to make about two dozen films on different aspects of aquaculture and capture fisheries technologies which are telecast regularly on national network and local TV channels and also screened in the field to the farmers by field level fisheries extension personnel of the State Departments of Fisheries. The Extension Directorate which is also a central level agriculture extension unit under the Ministry, also associates itself in the preparation of fisheries/aquaculture extension booklets with the help of the technical personnel of the Fisheries Division. Although it is a technical Division having all functions basically of technical nature, the Fisheries Division is headed by an administrator in the capacity of Joint Secretary. Fisheries professionals of the division include the Fisheries Development Commissioner and the Joint Commissioner (Fisheries). Deputy Commissioners of Fisheries assist them by taking care of particular resource area or discipline. In turn Deputy Commissioners are supported by Asst. Commissioners. Research Officers and Senior Technical Assistants of the Division assist their respective Asst. Commissioners (Chart-1).

State level extension services support

Fisheries development programme including aquaculture extension is executed at field level exclusively by the respective State Fisheries Departments. However, unlike agriculture where the department has the primary role of extension and mobilising support services for the farmers, fisheries sector is yet to start a dedicated and organized extension service. The reason being the multifaceted responsibilities thrown upon the Fisheries Department which covers extension, training, development of fisheries cooperatives, promotion of aquaculture, management of capture fisheries resources and operation of state owned fish farms, hatcheries, production and distribution of seed, fishermen's welfare etc. Besides, they also implement Central and Centrally Sponsored fisheries development and welfare schemes. The organizations differ considerably in the States and Union Territories depending upon the extent and nature of resources available and the

variations in the socio-economic profile and population distribution of the primary producers associated with the sector. However, a generalized organizational set up has been presented in Chart-2. There are two distinct divisions in such organizations, the administrative and the technical, both at the headquarters and in the field. Headquarters have the supervisory responsibilities and are also responsible for resource survey and statistics, planning, formulation of policies and programmes, administration and financial management and to carry out these functions some senior officers in the rank of Joint or Dy. Directors are posted at the headquarters. The cadre and number of such officers vary in different states depending upon the available resources and area of operations. Responsibilities assigned to these officers are also related to the type of resources such as reservoirs, freshwater aquaculture, brackishwater aquaculture, Farms/hatcheries etc., and also on the basis of disciplines like administration, planning and statistics, central schemes, etc. Most of these officers are directly controlled by the Chief, usually the Director of Fisheries. In some states, however, they are designated as Commissioner of Fisheries. At the field level, the organization is divided into Divisions covering a few districts. A Division is generally looked after by the Deputy Director of Fisheries (DDF) and in some States by Asstistant Director of Fisheries (ADF). The district level setup is headed by the District Fisheries Officer (DFO) and in some States as Fisheries Development Officer (FDO) who is responsible for overall supervision and implementation of all the fisheries development schemes and management of fishery resources and is assisted by Fisheries Officers (FO). The District is again divided into Sub-divisions and at that level the Sub-Divisional Fisheries Officer is responsible for implementation of all the schemes and plans and management of resources available within his jurisdiction. In some States, Block (made up of a number of villages) level organizations exist which are manned by Fisheries Extension Officers (FEO) or Assistant Fisheries Officers (AFO).

In most of the State level fisheries organizations there are no exclusive fisheries extension services as such. It is the development staff who perform multidirectional role like administration, resource management, implementation of fisheries regulations, survey, revenue collection and extension as well. In some states, although the field level officers are designated as Fisheries Extension Officers, in reality they are responsible for all regulatory and developmental actitivites, including extension services.

There are two major avenues for in-service training. Most of the state Fisheries Departments have developed their own training centres for providing short term in-service training to their newly recruited staff members. Such training usually varies from a few weeks to 3-6 months but not exceeding one year. The senior officers of the Department are invited to act as Resource Persons. The officers are also sent for in-service training at CIFE. The Institute offers four types of training programmes as detailed in the earlier section. Usually one candidate is sent by the Department every year for each of these categories of training and the selection is entirely on the basis of seniority in the Department. At times the officers and staff members also get opportunity to attend short-term specialized training programmes organized by different Institutes of the ICAR, Fisheries Faculty of Agriculture Universities and CIFE. However, considering the fast pace of aquaculture technology development and the growing needs for trained manpower in the sector, the opportunities for training are very limited.

3.2 Extension Policy, Planning and Programmes

The main policy guidelines for fisheries development are augmentation of production of fish and earning of foreign exchange from export of fish and fish products, besides generating

employment and improving socio-economic conditions of fisherfolk and other primary producers of the sector. Keeping such broad based policy guidelines in view, fisheries extension programmes are planned both at the Central and State levels and implemented mainly through the State Fisheries Departments. Besides the Fisheries Division at the Centre and the Fisheries Departments of State/Union Territory, there are also some other organizations with varying degree of responsibilities for fisheries extension. These are the Indian Council of Agricultural Research (ICAR) and its Institutes and Agricultural Universities, Marine Products Export Development Authority (MPEDA) under the Ministry of Commerce, and the Department of Biotechnology (DBT) under the Ministry of Science and Technology (Table-12 and Chart-4). All these organizations have their own extension objectives and area of operation. However, except for the Central and State Sponsored Aquaculture Extension Programmes, involvements of other agencies are limited.

3.3 Methods and Systems of Extension

3.3.1 Central and State sponsored aquaculture extension programmes

Fish Farmers Development Agency (FFDA)

Back in 1971, a Technical Committee was constituted under the Central Board of Fisheries to determine the steps and actions to be taken to popularize improved freshwater fish culture. This Committee while pointing out that aquaculture extension was the weakest link in the development of fish culture in India, recommended the formation of Fish Farmers Development Agencies (FFDA) to function as a "Service Agency" at the district level for promoting intensification of freshwater aquaculture in the country. Based on the Committee's recommendations and on the pattern of Small Farmers Development Agency (SFDA) in the agriculture sector, a Centrally Sponsored Pilot Scheme of FFDA was first launched in five selected districts in 1975. By the end of the Fifth Plan (1979), 50 FFDAs started functioning in various parts of the country. The National Council of Applied Economic Research and the World Bank Appraisal Mission reviewed the approach and impact of the ongoing programme and found the scheme as a suitable organizational framework. It then decided to have the FFDA approach as the nucleus of activity for Inland Fisheries Project with World Bank assistance in five potential states, West Bengal, Bihar, Orissa, Madhya Pradesh and Uttar Pradesh. This project envisaged development of 0.117 million ha of small tanks and ponds in 58 districts in the 5 States. The World Bank project which began in 1980 continued upto March, 1988 and the achievement of the project was far ahead of the set target. The number of agencies were subsequently increased and the programme expanded to cover more districts (Singh and Sampath, 1981, 1982, 1983). Chauhan (1993) highlighted the performance of FFDA scheme upto 1992-93 which shows that about 0.359 million ha of small tanks and ponds have been brought under scientific fish culture through 375 FFDAs. About 0.542 million fish farmers have been deriving benefit out of this scheme. It is noteworthy that the average national productivity of fish ponds and tanks which was a meagre 50 kg/ha/yr in 1973-74 went up to over 2075 kg/ha/yr in 1992-93 (Table-8). In the Eighth Five Year Plan (1992-97) it is expected that 0.2 million ha of water in the form of small tanks and ponds will be brought under scientific fish culture and 0.2 million fish farmers will be trained in improved aquaculture practices at the rate of 40,000 ha and 40,000 fish farmers per annum. About Rs.600 million has been earmarked for the FFDA programme during the plan period.

Operational Design

Except for a few regional level units, the FFDAs are basically district level organizations registered under Societies Registration Act and function as autonomous bodies under the Management Committee (MC) with the District Collector/District Magistrate as its Chairman. The members of the MC are officials drawn from the local offices of the Departments of Fisheries, Forestry, Irrigation, Cooperatives, Local Government Body (Panchayat), local Lead Bank, Block Administrative Unit etc., representatives of fish farmers and the Chief Executive Officer (CEO) of the FFDA. The CEO acts as the Member-Secretary and functions as the leader of the executive wing of the Agency and is responsible for the execution of the programme. The Management Committee normally meet once in 2-3 months to review the progress and also to ensure that the approved guidelines are followed in the selection of beneficiaries and water bodies /ponds for aquaculture, registering the identified beneficiaries as farmers of the Agency, allotment of the water body on long term lease, screening of project report for securing financial assistance from the local lead banks, conducting training programmes, pond improvement programmes, credit and subsidies flow, and appointment of staff etc. Typical organizational structure of each FFDA comprises four functional wings (Chart-3). The administrative wing consists of the CEO, Head assistant, Accountant-cum-cashier, Stenographer, Typist, Peons, Driver and Watchman. The Fish Seed Farm wing is responsible for producing fish seed and its distribution and is run by a Farm Manager or Farm Superintendent. The other two wings, the extension and the engineering wings are supported by Fisheries Extension Officer and Junior Engineer respectively. Staffing pattern of the World Bank sponsored FFDAs was slightly different. The staff strength of the extension wing is flexible with the provision of incremental staff with the increase in area of operation. One extra Extension Worker (EW) is provided for every 100 ha of operational water area and one additional Fisheries Extension Officer (FEO) is provided for every 10 Extension Workers. This staffing pattern is a generalized one. The actual pattern, however, varies in different States depending upon the area of operation, local conditions, nature and distribution of available resources and other local issues. Officers and staff required to run the FFDAs are deputed by the concerned State Fisheries Departments; and, in addition, FFDA also employs new staff as and when needed. The number of extension workers are built up over time as the project expands in its area of coverage.

Activities

The FFDA offers valuable extension and other support services to the fish farmers. Initially, the Agency surveys the available public and private ponds and tanks suitable for aquaculture and prepares a detailed list including a record of ownership. The ponds and tanks owned by Government, public institutions or local Government Bodies such as Panchayat, Municipality etc. are arranged to be given on lease to selected beneficiaries. Priority is given to weaker sections of the society or the Fishermen's Cooperatives. Leases are usually given on long term (7 to 9 years) basis on the recommendation of the MC. The selected beneficiaries are trained in fish farming through a fortnight long course either at the FFDA Farm/Training Centre or at the FFDA Unit Office. The farmers are given a daily training allowance of Rs. 25/per day and Rs.40/ as travel cost. The fishermen/fish farmers are offered technical advice on pond design and construction, know-how for excavation of new ponds or proper engineering guidelines for the renovation of existing ponds. Assistance is given in project preparation, processing loan proposals, preparation of pond, arranging seed for stocking. Also, pond site advice is given at frequent intervals. The

Agency also helps the farmers in getting credit from the local lead banks besides giving subsidies from its own fund earmarked for the purpose.

Individual method of extension through pond/home visit is also carried out in addition to organizing demonstrations in the farmers'ponds. Printed extension materials such as booklets/extension pamphlets on improved aquaculture practices prepared either by the local Agency or the respective State Fisheries Directorates are distributed among the fish farmers. A vehicle is provided to each Agency to facilitate mobility of the extension personnel. Provision has also been made for group method of extension through organizing meetings, screening film/video shows and celebrating Fish Farmers Day once in a year, usually at the district headquarters, to provide a forum for the farmers to share their experiences. They are also encouraged to raise their problems so that necessary solutions /remedial measures can be suggested. Depending upon the interest of the Local Unit and the State Department of Fisheries, prizes are also given to the best fish farmers or to the best agency. Successful case studies are also published as popular articles in magazines having mass circulation among the farming communities and extension personnel.

Culture technologies selected for transfer under FFDA

Mixed farming of three indigenous major carps viz., catla (*Catla catla*), rohu (*Labeo rohita*), and mrigal (*Cirrhinus mrigala*) has been practised in India for a long time but the average production rate has remained as low as about 600kg/ha/yr. A high yielding technology called Composite Fish Culture was developed during sixties at the Cuttack Research Station of Central Inland Fisheries Research Institute (CIFRI). Under the improved fish culture technology two Chinese carps viz., silver carp (*Hypophthalmichthys molitrix*) and grass carp (*Ctenopharyngodon idella*), and common carp (*Cyprinus carpio*) are included in the system of carp polyculture along with the three preferred indigenous carps thus making a six species culture system. The principle involved is the better utilization of natural production of fish food organisms in the pond. During the rainy season nutrient rich water enters the pond and under the tropical climatic conditions rich growth of planktons and macrovegetation takes place, forming important ecological niches which were not hitherto properly utilized by the indigenous carps. To utilize the available ecological niches phytoplankton eater silver carp and macrophyte eater grass carp were introduced. These six varieties of carps form an ideal combination in undrainable ponds mainly because of their different but compatible feeding habits viz., catla, a surface microscopic animalcule or zooplankton feeder; silver carp, a surface microscopic plants or phytoplankton feeder; common carp, an omnivorous bottom feeder; grass carp, a macrophyte feeder; Rohu, a column feeder; and mrigal, a bottom feeder (Kumar, 1992). The system of composite fish culture is thus a technique of optimum utilization of all the ecological niches of the freshwater undrainable pond ecosystem. A number of steps are being taken to increase the production of natural fish food organisms and their proper utilization by the stocked fish. These include (i) the preparation of ponds i.e. eradication of the existing population of predatory and unwanted fishes by the application of safe and locally available piscicide preferably of plant origin, eradication of aquatic weeds, liming and manuring; (ii) stocking with fingerlings in suitable combinations and in proper ratio and number; (iii) periodical but regular manuring with organic and inorganic manure; and (iv) supplementary feeding on daily basis in the form of indigenous raw feed ingredients such as rice/wheat bran and oil cake. Usually feed is applied daily at the rate of 1 to 2% of the body weight of the standing fish biomass in the pond. Aquatic vegetation or green animal fodder is given as feed to grass carp. Fish yields up to 10 ton/ha/yr has been recorded in experimental ponds. The technology was successfully demonstrated in different agroclimatic zones of the

country in State Government Farms under All India Coordinated Research Project on Composite Fish Culture and Fish Seed Production (Sinha, 1971/78). During the last 3 years, steps have been taken by CIFA and the Department of Biotechnology (DBT) to upgrade the technology; and, as a result, it is now possible to produce about 15-25 ton/ha/yr of carps from freshwater ponds through higher stocking density, aeration, application of balanced feed and water exchange. The technology has generated confidence among farmers and entrepreneurs and gained support from financial institutions (Dehadrai, 1993). The technology of composite fish culture thus offers different levels of operation with flexibility to suit the fish farmers with varied degree of techno-managerial ability and educational and financial background, and therefore it provides the technical backbone to the FFDA programme.

Recently, the culture of giant freshwater prawn (*M. rosenbergii*) has also been introduced as a technology package under the FFDA programme. This prawn is widely distributed throughout India and the seed are available both from natural sources and commercial hatcheries. The existing prawn hatcheries in the country has the capacity of producing about 70 million post larvae. They fetch about 4 times the price of carps and its growth rate in freshwater ponds under monoculture and in association with carps in composite fish culture has been found to be an added attraction for the farmers. Depending upon the availability of seed, juveniles are stocked at a stocking density of 2000 to 5000 per ha along with carps. It has been recommended that the technology should be extended at a faster rate so that by 2000 AD about 300,000 ha of ponds should be brought under integrated culture of prawn and carps.

For the effective transfer of the aquaculture technology package three sequential strategic steps are taken. The first step is to create mass awareness among the rural people about the advantages of fish culture as an economic activity which is largely achieved through the publicity drive by State Fisheries Departments, radio and TV programmes and the demonstrations from innovative farmers. The second step is to motivate individual or group of farmers to take up fish culture as a vocation. This is largely achieved through individual and group contact method. FFDA extension officers visit individual farmers to conduct resource survey and later on for convincing them about the production and profit potential and simplicity of the technology. Other positive aspects of the technology like wider scope for necessary modifications to suit the technical and financial ability of the farmer, possibility of quick return, provision of subsidies, minimum involvement of risk, low cost, local availability of inputs etc., are properly explained. Updating the technology is usually the third step in the extension service sequence. The Fisheries Division of the Central Government has recommended organizing at least two Total Aquaculture Technology Centres (TATCs) in farmers'ponds under each FFDA unit to ensure that all the practices of composite fish culture or its integration with other farming systems are strictly followed by the farmers including input use under the direct supervision of the FFDA Extension Officer and Staff (Singh and Sampath, 1983). Other neighbouring farmers are invited to witness the package of practices being followed and the result is displayed by netting the pond and sampling the stock. The Extension Officers are supposed to visit each and every pond under their command area at least once in a month, and discuss the progress and problems with the farmer and accordingly extend advice. Farmer's record keeping book has not yet been introduced. However, the Extension Officer keeps records of the information collected from the farmers.

Input Supply

Aquaculture has vast scope for growth particularly in a tropical climate like India where the rural undrainable ponds can use by-products of other farming activities as inputs for fish culture. Seed, feed and manure are the major inputs required for composite fish culture besides a few other materials like lime and natural piscicide of plant origin. Most of these inputs are locally available.

Immediately after the renovation of an existing pond or the construction of a new pond, lime is applied @ 200-500 kg/ha depending upon the quality of the bottom sediment. In some cases where dewatering and drying of the pond is not possible due to social, technical or economic reasons, preferred natural piscicide, de-oiled mahua *(Bassia latifolia)* oil cake is applied in the pond @200-250 ppm to eradicate the existing stock of predatory and unwanted fish. This is followed by liming the pond. The water soluble saponin content of the cake acts as piscicide while the residual organic matter acts as organic manure and promotes luxuriant growth of planktonic organisms in the pond within a fortnight. Toxicity lasts for about 10 to 15 days and after that the pond becomes ready for stocking. However, once the mahua cake is applied and care is taken to prevent the entry of predatory and weed fishes in the pond, similar application is not required at least for next 4 or 5 years. Due to the increasing demand and application in larger quantity, it is difficult to procure mahua oil cake in desired quantity in some parts of the country. In that case, bleaching powder (chlorinated lime) @ 50 ppm or a mixture of bleaching powder and urea is recommended as a substitute. Both organic and inorganic manure are applied to cultivate fish food organisms in the pond. Organic manure such as cowdung, poultry dropping, duck dropping, compost, biogas slurry, farm wastes etc., are the most commonly used organic manure, which are available locally as by-products of traditional household farming activities in the villages. Inorganic manure such as single super phosphate, urea/ammonium sulphate and muriate of potash which are widely used in agriculture are also easily available even in village markets. Supplementary feed which accounts for about 60 to 70% of the total cultural cost significantly influences the production rate. The most commonly used and recommended feed is the 1:1 mixture of rice bran and oil cake. Though these feed ingredients are easily available throughout the country, their use is still limited to less than half of the pond area under operation for composite fish culture mainly due to cost considerations.

Quality seed is one of the most important and critical inputs in aquaculture. The fingerlings are preferred to fry for stocking in composite fish culture ponds. Procurement of fingerlings of desired carp species in time is still a difficult task and as such the majority of the fish farmers stock their pond with fry. Very few farmers stock all the six species. Market preference, prevailing market price, non availability of seed are some of the reasons for such lapses. Some of the farmers stock their pond even with spawn. Considering the need for making available the quality seed of the desired species in adequate quantities at the right time, a component for seed production farms has been included in the FFDA system. However, except for the State of West Bengal (the major source of fish seed supply), Orissa and Andhra Pradesh, all other states are facing problems in this regard. Lime is another essential input which is easily available throughout the country. Potassium permanganate and common salt, the most common therapeutics used for treatment of common fish diseases are also easily available throughout the country at a reasonable price.

Subsidies

The provision of subsidy for the expansion of aquaculture is perhaps the major attraction for the farmers. Subsidy is given to the fish farmers as an incentive to ease the farmers' burden. The subsidy pattern presently being followed is given in Table-9. Subsidy for renovation of existing pond or construction of new ponds and first year material input cost are given to individual farmers for up to 10 ha of culturable area. There are some minor variations in the actual subsidy pattern in different states.

Credit assistance

FFDA also assists the farmers in credit mobilization from the local lead banks for meeting the costs involved in construction of ponds and culture operation. The estimates and detailed proposals are prepared by the Agency on behalf of the farmer quantifying the economic viability of the proposal and forward them to the local lead bank/Grameen bank for granting a loan. The criteria for forwarding the loan application also vary in different States. Surprisingly, rejection of application for loan is higher and at the same time recovery rate for loan is also quite low. Absence of trained fisheries field officers in the banks is one of the reasons for delay in processing the loan applications. The rate of interest and repayment period vary between 10-12.5% and 2 to 8 years, respectively. National Bank of Agriculture and Rural Development (NABARD) is an apex financing institution which provide refinancing facilities to all scheduled banks for agriculture and rural development, including aquaculture (Pathak-1993).

Control mechanism

Coordination and monitoring activities have been given adequate attention in the FFDA system and as such provision has been made for State and Central level Monitoring. The State Monitoring and Coordination Committee (SMCC) and the Central Monitoring and Coordination Committee (CMCC) have been set up to monitor programme implementation and coordination with other agencies, mobilise support for the programme and settle interdepartmental issues. CMCC includes representatives from ICAR, NABARD, Ministry of Finance, Secretary/Director of State Fisheries Department(s). The Secretary, Department of Agriculture and Cooperation, is its chairman. The Committee meets once in a year to discuss the standing issues and review the implementation of the programme. The SMCC is formed at the State HQ level and also supposed to meet once in a year to monitor the progress and state level coordination and to redress issues. For the proper management of the programme, project monitoring units have been formed both at the centre within the Fisheries Division and at the State level in the Directorate of Fisheries. The proceedings of the SMCC are conveyed to CMCC through Central Project Unit (CPU).The CPU consists of a Deputy Commissioner of Fisheries, Asst. Commissioner of Fisheries, Research Officer and Senior Technical Assistants. The State Project Unit (SPU) is formed by pooling the staff from Engineering service, Extension Service, Administration and Accounts and usually headed by one of the senior most officers in the rank of Additional Director/Joint Director or Deputy Director. Various types of reports generated from FFDAs are sent to their respective SPUs as per the fixed reporting schedule. The reports are examined by the SPUs and the evaluation report is sent to the Director of Fisheries, SMCC as well as to the CPU for their information and necessary action to be taken at their levels. Progress made under different components of the programme, level of achievements of set objectives and overall impact etc. are the points of consideration for making periodical evaluation. CPU receives the consolidated reports from different states and makes periodical evaluations

to identify shortcomings, constraints, limitations and problems encountered and accordingly prepares agenda note for the CMCC so that necessary decision may be taken by the Committee. Extension Officers collect the information from the fish farmers and after compilation of data, submit reports on resource survey, details of leasing of water areas, training of farmers, construction and reclamation of ponds, performance, distribution of subsidies and credit mobilization through Banks, seed produced in FFDA managed farms, seed distribution and stocking, inputs used etc. The report is sent to the SPU on monthly basis. Quarterly, half-yearly and annual reports are also sent to SPU where the information are compiled and state wise reports are prepared and sent to the Director/Commissioner of the state and also to the CPU. The reports are prepared on the basis of set proforma developed and circulated by CPU (Annex-1A-1 and 1A-2) and also locally developed by SPU (Annexure - 1B-1 and 1B-2). State level workshops/meetings are also organized at periodical intervals where the progress, performance, achievements in financial and physical terms are presented and discussed. Problems or limitations if any are also discussed to decide the actions to be taken to redress the same.

Brackishwater Fish Farmers' Development Agency (BFDA)

Brackishwater Fish Farmers Development Agencies (**BFDA**) have been established during the Seventh Five Year Plan period more or less on the similar pattern of FFDA. Like FFDA, BFDA are also District level autonomous organizations which provide a package of technical, financial and extension support to the brackishwater shrimp/fish farmers. Farmers are encouraged and given the required support to take up extensive and semi-intensive fish culture. So far, 34 such BFDA have been sanctioned in the country which have brought over 11000 ha of brackishwater area under shrimp farming in 9 maritime States (Table-10). Sampath (1993) has explained that similar to FFDA each BFDA has two important functional divisions, the Governing Body (GB) and the Executive body (EB). GB is headed by the District Collector as its chairman with members drawn from different developmental departments of the State (such as Revenue and Rural development), lead commercial banks and representatives of the brackishwater shrimp/fish farmers. The Chief Executive Officer (CEO) of the BFDA, who is drawn on deputation from the State Fisheries Department, acts as member-secretary for the GB. The EB is headed by the CEO and consists three functional wings - Engineering wing, Extension wing and the Administrative wing. After identifying the prospective beneficiaries, the Agency conducts training programme for farmers in brackishwater shrimp farming and farm management. It also prepares viable shrimp farming project proposals, and after processing, passes them to the local financial institutions for mobilizing credit support for up to 75% of the total project cost. The agency also extends financial assistance to the beneficiaries in the form of subsidy and assists the farmers in selecting sites, designing and constructing/renovating ponds, arranging the supply of critical material inputs such as quality seed, feed etc. It also provides necessary technical and extension support for culturing, harvesting, processing and marketing. On-the-spot advisory services are also provided on farm management, water quality management, disease surveillance, growth monitoring etc. It is expected that each BFDA will bring 50 ha of brackishwater area under shrimp farming per annum. Organizational structure of the BFDA is also similar to that of FFDA .

Subsidy pattern for BFDA is given in Table-11. The farmers are given training allowance of Rs.25/per day and Rs. 140/ for meeting the travel expenses, for attending a two month long training programme.

Control mechanism for the programme such as reporting system, coordinating, monitoring and evaluation procedures at different management levels of the programme is very similar to that of FFDA. However, due to the linkage with the new World Bank assisted project on shrimp culture in the three states (Andhra Pradesh, Orissa and West Bengal), the project has operational SMCC and CMCC for closer coordination & monitoring of the programme. In addition, the Government of India has appointed a consultancy firm for proper evaluation of the project (Sampath,1993). The format of the reporting proforma for BFDA is given under Annex-2.

Besides the establishment of BFDAs, the broad based programme for "Development of Brackishwater Aquaculture" also includes a component for the establishment of demonstration-cum-training centres for brackishwater aquaculture. An amount of Rs 0.5 million as one time grant is provided to each of the coastal States for this purpose. It has been proposed to create the practical training-cum-demonstration facilities for shrimp farmers, extension workers, farm managers, farm engineers through the establishment of pilot shrimp farming demonstration centres in all the maritime States and UTs during the ongoing 8th Plan period.

3.3.2 Extension Service Sponsored by State Governments

In addition to the extension activities under various centrally sponsored schemes, the State Department of Fisheries also do undertake aquaculture extension programme of their own on a limited scale. Such activities vary from state to state in its system design, activity and operation depending upon the available manpower, nature and extent of resources available and their own priority area for development. Such programmes are usually implemented through their District level units. Organizing a few short term training programmes of one to two weeks for the fish farmers, educated unemployed youths and extending subsidy are major components of State sponsored extension programmes. Such programmes are also supported by organizing Fish Farmers' Day and large scale distribution of printed extension materials in the form of bulletins /handouts etc. on aquaculture practices.

Transfer of Technology Programme Under ICAR

Although ICAR is not primarily responsible for extension in the country, a strong extension component, however, does exist under its first-line extension education programme which aims at demonstration of the technologies developed by its research institutes to farmers as well as the extension agencies. Testing and verifying the latest technologies in the socio-economic, agroclimatic and physical conditions of the farmers, analyzing the constraints in the adoption process and giving first hand scientific feed back to scientists, evolving models for transfer of technology as well as farming practices appropriate to local conditions, and promoting research on transfer of technology are the important elements of the functional system. Aquaculture extension activities are undertaken on a limited scale under several ongoing programmes of ICAR as mentioned below (Chart-4 and Table-12).

Krishi Vigyan Kendra (KVK) or Farm Science Centre

Krishi Vigyan Kendra are innovative rural institutions devoted to vocational training of farmers, farm women, educated youth, school drop-outs and field level extension functionaries. Dissemination of agricultural/aquacultural technologies relevant to the District in which it is located and on-farm research are important activities. "Krishi Vigyan

Kendra" is in fact a Hindi nomenclature, the English equivalent of which is "Farm Science Centre". The emphasis is always on the development of vocational skills through learning by doing. Work experience is the main objective in the training programme. In fact, the Council has launched a country-wide campaign for technical literacy through the net-work of 187 KVK. In the field of fisheries including aquaculture, 362 courses were organized and 5125 farmers were trained in different aspects of fish farming during 1991-92 (ICAR Annual Report-1992). Generally, short and long term need based training courses are organized in farmers'ponds. Farmers' fairs, Field Days, Farm Science Clubs, Film Shows etc. are also frequently organized to create mass awareness.

Farm Science Centres are run by the ICAR Research Institutes, Agricultural Universities and Voluntary Organizations as per the directives of ICAR. At least 3 KVK are primarily dedicated to aquaculture, while many others have aquaculture as one of the major areas of their activity.

Trainers' Training Centres (TTC)

To support the KVK network of system, eight specialized Trainers' Training Centres (TTC) are functioning for imparting training to the KVK teachers and field extension workers on the latest know-how in farming technology and training pedagogy. One TTC, based under CIFA, Bhubaneswar, is dedicated to aquaculture.

National Demonstration Programme (NDP)

The National Demonstration Programme (NDP) is based on the concept of "seeing is believing ". The NDP was initiated in the year 1965 by the ICAR to demonstrate the potential of new production technologies in the farmers'fields and for the scientists to see for themselves the validity, relevance and limitations of their experimental findings. It also gives an opportunity to establish close and strong two way direct link between the farmer and the scientist for further refinement of the technologies. Several demonstrations on the latest aquaculture technologies have already been organized under the programme.

All India Coordinated Research Projects (AICRP)

Besides testing the feasibility and economic viability of several newly developed freshwater and brackishwater technologies such as composite fish culture, fish seed production, culture of air-breathing fish and brackishwater pond culture under different agroclimatic conditions of the country, these projects were also involved in transferring technologies in selected areas. Training through demonstration was also organized at different Centres and Head Quarters of these projects for state fisheries officers, officers and extension personnel of FFDA system, officials of agriculture and rural banking sectors, entrepreneurs and fish farmers (Sinha,1971,1978 and Tripathi, 1982). These projects have now been concluded after achieving the desired objectives.

Operational Research Project (ORP)

On the basis of experience gained from NDP, Operational Research Project (ORP) involving an integrated approach to rural community problems through cooperation and involvement of local development agencies, financial institutions, rural development departments, voluntary organizations, Agricultural Universities etc. have been planned and are being executed in several parts of the country. A number of area and field specific ORPs are

functioning and quite a few of these have fish culture as one of the major components. The ORP on composite fish culture was initiated in March 1975 at Krishnagar, District Nadia, West Bengal and functioned for several years leaving a significant impact in that area. The project demonstrated the technology of composite fish culture and integrated fish-livestock farming in the State Government fish farms as well as in farmer's ponds and successfully displayed the technical feasibility and economic viability of the project (Sharma et al., 1978, 1979). Several other ORPs are now functional throughout the country having strong aquaculture component and are doing fairly well in the area of transfer of technology. An ORP under CIFE at Sultanpur is working on the productive utilization of wastelands through aquaculture development. There are over 7 million ha of wastelands in the country with highly saline soil and saline underground water and are unsuitable for agriculture. ORP (Fisheries) at Sultanpur has demonstrated the culture potential of brackishwater fish such as milk fish (*Chanos chanos*), mullet (*Mugil cephalus, M. parsia*), prawn (*Macrobrachium rosenbergii*) and brackishwater shrimp (*Penaeus monodon*) in the Government farm as well as in the private ponds. Operational training is also organized for fisheries officers, extension personnel of voluntary organizations, progressive farmers etc. on hatchery management of freshwater prawn using underground saline water and culture of brackishwater shrimp and fish. Within a short time it has created a strong and widespread impact in the area. All the ORPs have now been integrated to KVK of the area.

Lab To Land Programme (LLP)

The Lab to Land Programme (LLP) launched by ICAR in the year 1979 as a part of its Golden Jubilee commemoration has completed its Phase VII during 1991-92. The programme is being implemented through 104 collaborating centres throughout the country and it is bringing farmers, scientists and extension workers in close contact with each other and introducing low-cost farming technologies including aquaculture with a view to generating employment and income among the participating farm families. It has, so far, covered 24,000 farm families classified as small and marginal farmers, in particular those belonging to weaker sections of the society like scheduled castes, scheduled tribes and backward communities. Each farm family is given limited input assistance worth up to Rs. 500 per family as incentive. The results have revealed that with a limited critical input assistance but strong extension support the farmers have been able to increase their productivity manifold. Diversification of activities is reported to have helped the farmers in increasing employment by about 100% and income by about 60% (ICAR Annual Report, 1991-92).

The programme has several in-built sequential steps to follow. Selection and adoption of required number of small and marginal farmers and pondless farm labourers or rural poor, survey of the available aquaculture resources in the area, developing and implementing suitable aquaculture activities involving the members of the adopted farm families, scientists of the research Institutes, extension officers of the State Fisheries Departments, faculty members of Agricultural Universities, local administrators etc. are some of the designed functional steps of the programme. Besides promoting methods and result demonstrations in farmers ponds, training is also organized for the members of the participating families as well as other progressive farmers, educated unemployed and farm women of the locality, in appropriate aquaculture technologies including integrated fish farming.

Most of the Fisheries Research Institutes of the ICAR are participating in the LLP and are transferring suitable technologies developed by these institutes. The programme offers opportunity to test the technologies in the field, and get strong feed-back from the fish farmers to the laboratories/scientists concerned which helps in further refinement/modification of the production technologies in most appropriate manner and at a much faster rate.

Research for Tribal and Backward Areas (RTAB)

Tribals and scheduled caste communities have been considered to be the weakest sections of the society and hence ICAR is operating about 45 project centres to work for the benefit of 267 economically and socially weaker sections of the Indian society. The main emphasis is on the identification of appropriate technology packages and their implementations. Production packages of both freshwater and brackishwater aquaculture have been introduced with varying degree of success.

Transfer of Technology Under Marine Products Export Development Authority (MPEDA)

The Marine Products Export Development Authority (MPEDA) was constituted under an Act of Parliament in 1972 to look after the promotion of exports of marine products from India. Central Ministries (Agriculture, Finance, Foreign Trade, Industry, Shipping and Transport), Department of Fisheries of Maritime states, various segments of the Fishery Industry and Trade, and National Fisheries Research Institutes are represented in the Board of the Authority. Under the statutory provision, MPEDA has to perform a comprehensive role covering promotion of aquaculture, fixing and maintaining export standards of products, building infrastructure for proper development of aquaculture, harvesting and post-harvest marketing, collection of statistics on production, promoting exports, and imparting training on various aspects of the industry and trade (Sakthivel, 1993).

MPEDA plays an active role in promoting brackishwater aquaculture in the country and has initiated several schemes to promote shrimp farming in the private sector in the maritime States.

Shrimp farming in India has taken a new dimension in recent years due to country-wide awareness of scientific farming and its techno-economic viability created largely by MPEDA's efforts through several promotional/demonstration programmes. Several entrepreneurs have started investing into this venture. The Authority has established several field offices in all the maritime States such as Valsad (Gujarat), Alibagh (Maharashtra), Karwar (Karnataka), Kochi (Kerala), Thanjavur (Tamil Nadu), Vijayawada (Andhra Pradesh), Bhubaneswar (Orissa) and Calcutta (West Bengal) to render field services to farmers /entrepreneurs to take up scientific shrimp culture technology. Prompt services to farmers are provided right from site selection to harvesting and marketing. The authority has developed considerable support service infrastructure to extend services like preparation of project reports for arranging institutional credit, farm designing, construction, pond preparation, seed procurement, *selective stocking*, post-stocking management etc. Some of the critical inputs required for shrimp culture such as seed, feed, mahua (*Basia latifolia*), oil cake, etc. are also arranged on cost basis.

Besides these services, MPEDA also regularly conducts short term training programmes at regional levels, organizing farmer's meets, seminars, workshops and inter-state study tours for the benefit of the shrimp farmers. Long duration training programmes on shrimp

farming and hatchery management, design and construction of farms and hatchery are also being conducted at regular intervals for State fisheries officers, extension workers, prospective entrepreneurs, teaching staff, etc. in an exclusive training complex at Kochi.

In order to achieve higher production through brackishwater aquaculture the following schemes are under operation.

- Promotion of commercial hatcheries for seed production.
- Assistance for development of new farms and increasing production from existing farms.
- Transfer of commercial aquaculture technology.
- Imparting training in aquaculture to the weaker sections of the society.
- Establishment of spawner banks.
- Participation in setting up of Integrated Aquaculture Units in the form of equity.
- Supply of seed from its two commercial hatcheries.

  In addition to the subsidies (Table-13) and above mentioned promotional activities, the Authority also mobilizes assistance from other organizations. MPEDA also extends technical service support for the establishment of hatcheries in the private sector.

Satellite farming approach

Recently, MPEDA has introduced "Satellite" or "Cluster" farming approach . This model is new to India. However, such models are successfully practised in South-East Asian Countries. The corporate houses are encouraged to set up nucleus facilities consisting of farm, hatchery, feed mill, processing plant, research and development unit and supply of essential inputs not only for their own farms but also for the small and marginal shrimp farmers of the same locality (Anon, 1992). Such a concept is expected to ease the local tension where the corporate sector, small farmers, bankers and traders work together in a mutually beneficial way (Kumar , 1993).

Department of Biotechnology (DBT)

In addition to their R & D programme dedicated to the field of biotechnology, the Department has also paid special attention to demonstration projects to establish the techno-economic viability of the proven aquaculture technology packages and to induce wider adoption. Recently, several aquaculture technologies, both in freshwater and brackishwater areas have been perfected and successfully demonstrated creating strong impacts. The semi-intensive shrimp culture demonstration has been organized in collaboration with MPEDA at Nellore and also at Paradeep. The results showed an average production of about 5 ton/ha/crop while the highest production level reached 6.8 ton /ha /crop (TASPARC,1992 and 1993). Low cost package demonstration in unfavourable water conditions at Paradeep achieved production rate of 1.8 ton/ha/crop. Development of improved technology package of semi-intensive shrimp farming and pilot scale demonstration has created strong impact among entrepreneurs who are now coming forward in large numbers to take up semi-intensive shrimp culture.

In the field of freshwater aquaculture, the DBT in collaboration with CIFA has further intensified the composite fish culture technology package and demonstrated fish production at the level of 15 ton/ha/yr in 1991. The programme aims at achieving the production level of 25 ton/ha/yr. through pilot scale demonstration. Occasional training

programmes are also organized at the demonstration centres for entrepreneurs (Anon,1993; George John, personal communication).

3.4 Non-Government Organizations (NGOs) in Aquaculture Extension

Although very little information is available on the contribution of voluntary organizations in aquaculture extension, some of these organizations are doing commendable work. Rama Krishna Mission, World Lutheran Service, Don Bosco Society, Tagore Rural Development Society, Kamala Nehru Trust, Nehru Yuva Kendra, etc., are actively associated with aquaculture extension services in different parts of the country. Among the prominent NGOs involved in aquaculture extension, the Society for Rural Industrialization (SRI) is the pioneer organization transfering fish culture technology to the grass root level in the tribal belt of Bihar. The society is also running the programme on transfer of aquaculture technology to support other NGOs of the area with the assistance from Council for Advancements of People's Action and Rural Technology (CAPART). As a promotional service, SRI imparts need based training to the extension workers of the local NGOs and the farmers. SRI with assistance from CAPART has supported several NGOs to establish fish hatcheries to meet the growing demand for fish seed. The demand of fish seed has suddenly gone up due to the extension efforts of the local NGOs like Shramjivi Unayan and Jan Jagran Kendra etc. (Singh, 1993). Several prominent NGOs having widespread area of operation have now introduced the concept of net working among the local NGOs for aquaculture extension activities. Action for Food Production (AFPRO), a Delhi based organization having its operation in several States of India has pointed out that the fishermen cooperatives and small NGOs have shown their inability to take advantage of Governmental programmes and provisions due to various inadequacies such as complicated procedures and formalities, and lack of knowledge and skills. To overcome such difficulties, AFPRO is promoting a network of NGOs working with socio-economically weaker sections of rural society. The network partners meet at least once in a year besides other occasional meetings/consultations specifically for identifying the problems of fisheries/aquaculture development *vis-a-vis* rural development and sharing of success/failures encountered. NGO network members are helped by AFPRO for preparation of viable and appropriate projects and mobilize funding support. AFPRO team of specialists also visits the projects for making critical review of ongoing programme and suggest necessary changes/modifications in the strategy, approach and target. Such networking of NGOs for aquaculture extension/rural development has been initiated in several States including Andhra Pradesh, Orissa, Bihar, Uttar Pradesh, Haryana, etc. Organizing rural poor, training them in appropriate fisheries/aquaculture technologies and other allied vocations, getting public water bodies on lease, introducing group saving schemes, mobilizing group loans, assisting them to initiate aquaculture and help them in marketing their products, etc. are the main functions of AFPRO.

Steps have also been taken by the Government to encourage more and more involvement of NGO's for rural development programmes. The council for Advancement of People's Action and Rural Technology (CAPART) has been established and registered under the Societies Registration Act with the merging of People's Action for Development India (PADI) and Council for Advancement of Rural Technology (CART). The CAPART aims at encouraging, promoting and assisting voluntary action for enhancement of rural prosperity. In pursuance of these objectives, CAPART makes available financial assistance to voluntary organizations under several ongoing schemes of the Central and State Governments. CAPART sanctioned 7,375 projects worth 1450 million rupees upto mid-1992, and many of these projects have aquaculture extension services.

Panchayati Raj Institution

Panchayati Raj Institutions are in existence in almost all the States and Union Territories with variations in structural pattern. The system involves a three tier arrangement, village level (Gram Panchayat) ,block level (Panchayat Samittee) and district level (Zila Parisad). Nomenclature, however, varies in some States. The tenure of Panchayati Raj Institutions ranges from 3 to 5 years. These village level institutions are responsible for promotion of agriculture, livestock, aquaculture and rural industries; provision of medical relief; maternity, women and child welfare; maintaining common grazing grounds, village roads, tanks, wells, sanitation; and execution of other socio-economic and welfare programmes. In some places they also provide primary education and collect land revenue. There are about 0.22 million Gram Panchayats, 53 000 Panchayat Samitees and 351 Zila Parishads in the country.

The Public water bodies are vested to Panchayat. Panchayat Samittees lease out these water bodies to the poorer sections of the village, either individual or group, for taking up aquaculture preferably through FFDA or NGOs supported programmes.

3.5 Extension and Research Linkage

ICAR is an apex body responsible for promoting, conducting and coordinating research, education and primary extension education in the fields of agriculture including aquaculture and fisheries. It has created a National Grid of Cooperatives Research in which 46 Central Research Institutes, 22 National Research Centres, 71 all India Coordinated Research Projects and 27 Agriculture Universities participate in conducting research on fundamental and applied aspects of individual crops, commodities and disciplines which have direct relevance to agriculture, animal husbandry and fisheries including aquaculture. Details of institutions in the field of aquaculture have already been given in the earlier sections. ICAR also conducts first-line demonstration for the transfer of improved technologies to the State extension functionaries and the village level workers, as well as selected fish farmers. The Council has been associated with projects like NDP, ORP, LLP and centres for upliftment of scheduled castes and tribes besides operating a network of 187 Krishi Vigyan Kendra (Farm Science Centre). All these programmes facilitate direct linking of research and extension, scientists and extension/development workers and up to a limited extent scientists and farmers (Chart-5).

Research - Extension Linkages at Central level

A Coordination Committee on Research and Development is functioning under the Chairmanship of D.G., ICAR, as a link mechanism between senior officers of the ICAR (DDG/ADG Fisheries) and the Department of Agriculture and Cooperation (DAC) which also includes Fisheries Division.

Regional level

ICAR has divided the country into 8 regions. To monitor the progress and problems as well as to provide a strong linkage between research and extension at regional level, 8 Regional Committees have been formed in which the ICAR, State Agricultural Universities and the State Departments of Agriculture, Horticulture, Animal husbandry and Fisheries interact to identify problems that require attention of national agricultural research and education system. Minister of Fisheries, Director/Commissioner of Fisheries and Director of Fisheries

Research Institute(s) of the region are among the members of the Regional Committees. It has been pointed out that in the past there was inadequate participation of the Senior State Officials from the State Governments for whose benefits the Regional Committees have been created (Chopra-1993). The Governing Body of ICAR, therefore, constituted a Sub-Committee to make a review and suggest methods of making the Regional Committee meetings more meaningful and fruitful. Based upon the report of the Sub-Committee, steps are being taken to restructure the modus operandi. The agenda of the meeting is now expected to be drawn in such a way that the proceedings of the meetings are centered around location specific problems and that possible solutions are elicited from the State Agricultural Universities and ICAR Institutes / projects in the region. There will be a status report on each region giving information on research and extension linkages and progress of research in the region. The status will be upgraded every five years. The membership of the Committee has been enlarged by including the Secretaries and Commissioners of Fisheries and other departments. It has also been proposed to include two representatives of NGOs of the region and holding the meetings once in two years (Chopra, 1993).

State level

All the TOT (Transfer of Technology) projects are annually reviewed under the chairmanship of the Vice - Chancellors of the State Agricultural Universities. Officers of the State Departments of Agriculture/Fisheries/Animal husbandry are invited to these annual review meetings.

In addition to these linkages, annual Fisheries Zonal Meetings organized by the Fisheries Division, DAC, Central Government, under the Chairmanship of Additional Secretary / Joint Secretary also provide important functional linkages where the Deputy Director General / Asst. Director General (Fisheries) of ICAR, and senior representative from Planning Commission, NABARD and Commercial Banks, and Directors/Commissioners of Fisheries of the State Fisheries Departments also participate.

Besides, the transfer of technology from research institutions to the extension and development department personnel are made through research literature, popular articles, occasional visits of Scientists to the field and training organized at ICAR Institutes and Fisheries Colleges run by SAUs. CIFE provides most of the fisheries training in India. The Institute conducts courses in aquaculture techniques and extension methodologies at its headquarters and several regional/resource based training centres for different levels of Fisheries Officers, Extension Workers of the State Fisheries Departments, NGOs and other organizations engaged in aquaculture development. Taking research inputs from the ICAR Institutes and SAUs, the institute has developed comprehensive aquaculture training packages. Besides CIFE, some specialized Fisheries Research Institutes such as CIFA, CIBA, CMFRI, CICFRI, etc. also conduct ad-hoc short-term training courses on aquaculture technologies incorporating their recent research findings. Nominations are invited from different State Fisheries Departments and other development/extension agencies. Occasional workshops on aquaculture or its specialized and allied aspects are also organized often by these research institutes to offer opportunities for strong interactions between the research and extension personnel. Trainers' Training Centre (Fisheries) is attached to CIFA which gets all the information pertaining to aquaculture research in freshwater and in turn imparts training to State level extension officers and aquaculture operators.

4. PRODUCTION, MARKETING AND ECONOMICS

4.1 Production Potential

Recent studies conducted by Ranadhir (1989) on the viability of composite fish culture with different levels of inputs clearly show that the technology is economically viable regardless of the level of technology/input used. However, under field conditions and especially under FFDA area of operation, there has been a great variation in the adoption of proper culture practices and level of management by the farmers. A comprehensive evaluation of the FFDA programme was conducted by the Centre for Management of Agriculture (CMA) at IIM (Srivastava *et al.*, 1993) taking a large sample of 2,202 fish farmers on random sample basis from the entire country. The study also included details of production and profit functions. For the country as a whole, the average yield/ha for three years period (1986-87, 1987-88 and 88-89) was 1,630 kg for all categories of farmers taken together. The small farmers achieved the average yield rate of 2,688 kg/ha/yr; while the average yield rates for the medium and large farmers were 1,576 kg/ha/yr and 1,056 kg/ha/yr respectively. For the year 1992-93, the average yield has been estimated at 2075kg/ha/yr. Punjab has attained the top position in 1992-93 by achieving an average production of 4080 kg/ha/yr (Lal, 1993).

Like freshwater aquaculture, the yield pattern in brackishwater aquaculture sector also exhibits great variations. The yield is greatly influenced by the levels of technical and material inputs used. Based upon the demonstrations and data collected from the field, MPEDA has presented practical estimates of average yield through extensive and semi-intensive shrimp culture technology packages (Table - 15A & 15B). However, the culture practice, in general, is still more or less of extensive type and as such in actual term the average production works out to be between 500 - 600 kg /ha/yr. The average yield achieved by a number of entrepreneurs following semi-intensive system of culture, however, is around 6-10 tons/ha/year. So far, about 11,500 ha of brackishwater areas have been brought under mainly extensive farming in Orissa, Andhra Pradesh, West Bengal, and Kerala through BFDA where production is estimated to be around 400 kg/ha/yr (Joseph, 1993; Sampath, 1993). Culture of brackishwater fish such as milk fish (*Chanos chanos*), mullet (*Mugil spp.*), Bhetki (*Lates calcarifer*) etc. showed a production level between 1 and 3.5 ton/ha/yr, which again depends on the level of technology followed and inputs used.

4.2 Marketing

Product marketing of any production system is the core activity upon which the future of the industry depends considerably. In case of aquaculture this operation assumes greater importance due to the highly perishable nature of the product. Considerable portion of the freshwater aquaculture product is sold in fresh condition. In the absence of easy accessibility to the market, fish is sold to the middlemen at the farm gate invariably at a much lower price than it would have fetched in the retail market. In addition to the seasonal variations in the market price, fish prices increase due to increased demand during the time of religious and social celebrations. The volume of fish sale is normally at its peak during March/April mainly due to increased harvesting activity prior to pre-stocking pond preparation for the next crop and also due to fast decreasing water level in the ponds during summer months (Kumar, 1992). Srivastava *et al* (1993) presented a comprehensive picture of marketing pattern of freshwater aquaculture products. The study shows that production from freshwater aquaculture is largely consumed in fresh form. Over three

fourth of the products are consumed in rural areas, while less than one fourth is consumed in urban areas. Product flow pattern in the rural area shows that only a small fraction of the product (2%) moves beyond 100 km. Ice is used to preserve the fish in bamboo baskets during transport and temporary storage. However, the same is not true with some of the States like Punjab, Andhra Pradesh, Haryana, etc. About 80% of the fish produced in Punjab goes beyond the state (Lal, 1993). More or less same is true with Haryana and neighbouring states, while over 90% of the freshwater aquaculture products from Andhra Pradesh move away to distant places such as Calcutta and other cities of West Bengal, Orissa, Bihar, etc. Ice is the usual means of preserving the fish in bamboo basket wrapped in gunny bags. Nowadays, major portions of the consignments from Andhra Pradesh are transported by insulated trucks while the smaller quantities are transported through rail route. Calcutta is the major market and consumption centre of freshwater fish which alone consumes about 10% of the total freshwater fish produced in the country.

Freshwater fish marketing is controlled by powerful marketing intermediaries. Studies conducted by IIM team shows that the sampled farmers disposed of their fish to merchants at the pond site or in local markets. The disposal to merchants or intermediaries included whole sellers, commission agents, local retailers etc., and accounted for 63.01% of sale. The sale to merchants at pond site is the highest in eastern zone while lowest in the western part of the country. Four or five intermediaries are involved in bulk marketing of freshwater fish (Kumar, 1993).

Price of fish is also related to state of freshness of the product. Fresh fish fetches a better price and are in greater demand than iced fish. Direct sales to cooperatives/corporations are limited and even when fish farmers sell to cooperatives/corporations, private intermediaries are involved (Srivastava 1991).

The farmers' share of the consumer rupee usually varies between 36.5% and 79.3% depending upon the involvement of the number of intermediaries (Srivastava *et.al, 1993*). The share varies between 66.1% and 79.3% when one intermediary is involved. In case of aquaculture in ponds and tanks the farmer's share in the consumer rupee is relatively high but the consumer price of fish is very low (Srivastava *et.al.*, 1991). Studies conducted by IIM showed that only in the western region FFDA played limited role in fixation of sale price of fish.

Market pattern has also influenced the technology package of composite fish culture. In Andhra Pradesh, Punjab and Haryana farmers largely prefer Indian major carps for culture due to market preference and higher price for native carps. In Andhra Pradesh, farmers commonly culture native carps viz., catla, rohu and mrigal. Among the exotic species, they prefer grass carp as it looks very similar to native carp mrigal, grows relatively faster and fetches better price. The price range also depends upon the size range of fish. Bigger size fish fetches 20-40% higher price and as such the farmers have now resorted to stocking bigger fingerlings at the rate of about 2,500 to 3,000/ha against the recommended rate of 5,000-6,000/ha. At lower stocking rate, the fish usually attain average size of over 2 kg within one year.

It is estimated that of the total production from brackishwater farms, 57% is for exports, 38% is consumed in domestic market in fresh form and the remaining 5% is consumed in dried form.

The exportable commodities move through up to 4 hands. Farmers sold 17% directly to processing units, 42% through commission agents, 28% directly to wholesalers and another 12% to peeling shed owners who worked as wholesalers. Of the total production, 42% was sold in auction, 17% directly to processors on fixed prices and the remaining 41% to wholesalers and peeling shed owners (Srivastava, 1991).

4.3 Culture Economics

Similar to other farming operations, three important factors viz., the production levels, operational cost and price realization influence the economics of aquaculture practice. Since a great range of variations exist within these factors in different agroclimatic zones of the country, the economics of aquaculture also vary from State to State.

Based upon the comprehensive studies on economics of aquaculture operations conducted by IIM team taking large sample of farmers from FFDA programme as well as from other sources, a generalized picture of an one ha farm has been presented (Srivastava, 1991). Ranadhir (1989) has worked out the economics of composite fish culture at three different levels of technology and inputs used (Table 14 A, 14B and 14C). It shows that at 1989 price levels farmers can achieve production and net profit to the tune of 9,000 kg/ha/yr with Rs.80,000, 6,000 kg/ha/yr with Rs.63,000 and 3,000 kg/ha/yr with Rs.22,000 under high, medium and low levels of technology practices respectively. The total cost of production including fixed and operating costs worked out to be Rs.110,000, Rs. 57,000 and Rs.38,000 with high, intermediate and lower technology levels while keeping the sale price of fish at Rs.20/kg. Srivastava (1991) also calculated the economics of one ha model farm based upon the data collected from different sources and at different levels of technology adoption and price realization (Table 16A-1, 16A-2). He observed a direct relationship between levels of inputs used such as feed, fertilizer and management levels and overall productivity. In his calculation he kept the sale price of fish at Rs.9/kg against the consumer price of over Rs. 40/kg in major terminal market at Howrah (Calcutta). His analysis showed that at production rate of 2,000 kg and the sale price of Rs.9/Kg, the operating cost incurred by the farmers worked out to be Rs.6,275 with net income of Rs.11,725. At the next level of technology with doubling the levels of inputs such as feed and fertilizer, the yield can be doubled with better size range of product. Through a little better market strategy, the farmer can get Rs 18/kg and a net profit of Rs 60,530/ha. Assuming a further improvement in management level and a further increase in the feeding and fertilization rate, the farmer can get production at the rate of 5 ton/ha/yr and better size of fish to sell @Rs. 25/Kg. At this level, the net profit is expected to be to the tune of about Rs.104,420/ha (Table 16A - I & 16A-II).

All these studies clearly indicate the economic viability of composite fish culture regardless of the level of technology and input used. However, the margin of profit increases with the better level of management and increased use of inputs.

Economics of brackishwater aquaculture have also been worked out by many agencies. Srivastava (1991) has pointed out that construction of brackishwater farm/pond requires relatively high capital investment. If the land is developed and cluster of ponds are constructed by Government Agency such as BFDA and individual ponds are leased out to fish farmers at an annual rate of Rs.9,000/ha including the cost of maintenance and repair, the economics of an one ha model farm is shown in Table-16B-I and 16B-II. He has

worked out the economics of one ha pond under operation by fish farmer and his family for shrimp culture, separately for *P. indicus* and *P. monodon,* at three different levels (I, II & III) of technology package and inputs used, with production of 2000 t, 4000 t and 5000 t per year. He calculated the economics based on the sale price of prawn @ Rs 45/kg for *P.indicus* and Rs 50/kg for *P.monodon,* the prevailing price in 1989. However, the current price range is Rs.150-160/kg for *P.monodon* and Rs.100-125/kg for *P. indicus.* However, the product is mainly for export and the current price of shrimp reflects the depreciation of the Rupee.

5. SOCIO-ECONOMIC BENEFITS

5.1 Employment

It is a general notion that aquaculture is not a labour intensive operation and as such employment opportunity is minimal in this subsector. A detailed study conducted on labour use pattern in aquaculture taking sample farmers from across the country has shown that the total labour input of fish farmers is equally divided between family labour and hired labour. FFDA evaluation team found that for all categories of fish farmers taken together, the use of average family labour was 78 days and average hired labour 77 days per ha per year of aquaculture operation. The corresponding figures for cooperatives were 131 and 150. Thus the total labour input has been found to be on an average 155 days for fish farmers and 281 days for cooperatives. In agriculture, the average labour input is 105 days/crop. However, there are marked variations in the use of hired and family labour input across the country.

In brackishwater aquaculture, it is estimated that depending upon the intensity of aquaculture and level of technology adopted, labour input varies between 200 to 400 days/ha, excluding the labour used in harvesting and maintenance of ponds.

In addition to direct employment generation, indirect employment also increases on account of construction of pond, renovation of pond, packing and transport, ice plant operation, harvesting, seed production, seed marketing, feed industry, etc.

5.2 Additional Family Income

After careful and comprehensive evaluation of a large number of studies from All India Coordinated Project on Composite Fish Culture and IDRC's Rural Aquaculture Project, it was concluded that fish farmers who adopted improved carp culture technology even at a lower level of input use have obtained profits of at least Rs.15,000/ha of culturable water area in about one year time at 1980-81 price level. It indicates that they get 8 to 10 times more profit than they were getting earlier from traditional operations. Profit range of Rs.50,000/ha/yr to Rs. 68,000/ha/yr is possible with intermediate and high levels of input use respectively (Ranadhir, 1984,1986,1987).

FFDA evaluation mission has also presented the impact of the programme on family income and employment generation. It shows that at all India level, the average gross income for all categories of farmers was Rs.13,944/ha; whereas Rs.36,554/ha, Rs.22,270/ha and Rs.10,049/ha was worked out for small, medium and large farmers respectively. For the country as a whole, the average net income earned by all categories of farmers was found to be around Rs.9,076/ha and the estimates for three categories of farmers were Rs.12,915/ha, Rs.11,464/ha and Rs.6,864/ha for small, medium and large

farmers respectively. The net income was 65% of gross income for all categories of farmers (Srivastava et. al.,1993). Net family income per beneficiary, however, varied from one State to another on account of differences in average size of pond, yield rates per hectare, average price of fish produced, and cost of inputs.

5.3 Progress, Constraints and Potential

Progress

Although several organizations are involved in aquaculture extension in India, except for the State Departments of Fisheries, others have limited role to play. Through its various first line demonstrations and other extension programmes, ICAR attempts to achieve its objective of forging a closer and direct link between research and extension and also to receive direct feed back from the farmers for further refinement of the technologies and making them more relevant and suited to field conditions. DBT's role is an indirect one and is restricted to identification of potential areas, extending funding support to research organizations for the improvement of technologies and pilot scale demonstration of technology packages, and thereby creating awareness among the progressive aquaculturists and entrepreneurs of that area. Keeping its prime objective of promotion of exports of marine products, MPEDA on the other hand concentrates mainly on the well to do farmers, progressive and innovative new comers to the sector, entrepreneurs and corporate houses in the field of brackishwater aquaculture. However, through its recently introduced approach of cluster farming, small and marginal farmers are also bound to get extension services support. Fisheries Division of the Central Government without having staff at grass root level plays primarily the role of planning, policy making and national level coordinating agency. However, through its limited HQ staff and three training institutions, the Division contributes towards training of State Fisheries Extension Personnel and monitors the national aquaculture extension programmes such as FFDA and BFDA. The role of the Directorate of Fisheries in States has been restricted to implementation of FFDA, BFDA and other limited number of development schemes besides regulation of fisheries activities. The State Fisheries Departments, however, through the implementation of centrally sponsored FFDA and BFDA system approach has provided a definite extension infrastructure base and created significant extension impact by increasing aquaculture production in both freshwater and brackishwater subsectors. The average fish production which was as low as 50 kg/ha/yr prior to introduction of FFDA concept in freshwater aquaculture (1973-74) has gone up to 2075 kg/ha/yr in 1992-93. Similarly, BFDA programme has also brought significant positive changes in the brackishwater aquaculture subsector. BFDA programme has helped in bringing about 11,000 ha of brackishwater area under shrimp culture in the maritime States and is expected to bring several fold more area within the next few years. The average production rate has also gone up between 500 and 600 kg/ha/yr.

Constraints

Aquaculture production is primarily a function of technical and managerial inputs. Production rate is expected to increase with further refinement of the available technologies, development of new production packages and improvement in managerial skill. It thus requires concerted efforts towards development of culture technology packages and more vigorous attempts for the transfer of such technology packages to the users. It thus implies quick and large scale motivation of fish farming communities to learn and use the technologies and mobilization of essential materials and technical inputs at

their door steps. All these emphasize the need for a well organized and dedicated Aquaculture Extension Service. Similar views have also been expressed time and again by many people in India (Singh and Sampath, 1981, 1982, 1983, 1990; Radheshyam and Kumar; 1982, Tripathy *et al.*, 1982). Several Expert panels and committees have also highlighted the importance of extension in fisheries sector (Anon, 1976, 1989). However, inspite of all these it continues to be the weakest component. Aquaculture Extension Services are provided mainly through the FFDA and BFDA programmes and these have been found to be too inadequate to disseminate the improved aquaculture technology packages throughout the country.

Staffing of Extension Services is a major problem. At present, one extension worker has to cover 100 ha water area which becomes physically impossible to provide timely help to fish farmers. Inadequate staff, typical bureaucratic and hierarchic outlook of agencies, unskilled, untrained or poorly trained extension personnel, responsibility for large operational area, lack of transportation, lack of incentives or encouragement for field job etc. have resulted in poor extension services setup. Although a vehicle is provided to each agency, it is used mainly for administrative purposes rather than extension activity. Lack of proper extension management system is the root cause of the present state of affair of extension services in the country. These organizations are greatly influenced by the bureaucratic pattern of district administration and the techno-bureaucratic style of the State Department of Fisheries. Although these agencies are supposed to be autonomous, the Department of Fisheries decides the posting, promotion and transfer of their staff.

Unlike agriculture, the extension divisions of the existing fisheries research and education institutions are poorly organized and need to be strengthened with immediate effect to meet the growing challenges.

The review of the past activities of the programme reveals that adequate attention was not paid towards transfer of technology. On the whole, farmers did not show inclination to pond preparation which usually accounts for over 50% of the probability of success in fish culture. For the country as a whole, only 3% of the farmers went for silt removal and less than 6% for removal of predatory and weed fishes. Even initial liming and manuring was attempted by only 23% of the fish farmers. Stocking pattern also showed much variation from the recommended practice in stocking density, stocking ratio and size of the stocking material. Average figure for stocking comes to around 42,000 fingerling/ha against normal recommended rate of about 5000 to 6000/ha. Similar trend was also noticed in case of feeding and manuring schedules. Feed and fertilization schedules were adopted only in 40% and 62% of the pond area respectively and that too on casual basis (Srivastava et.al, 1993). All these facts and figures clearly indicate that the recommended aquaculture technologies have been disseminated at a very slow pace.

Aquaculture extension personnel are supposed to give all possible technical advice to the farmers. They are also expected to help them in soil and water analysis, and accordingly advice on manuring and feeding schedules, environmental monitoring, disease diagnosis and health care etc. But surprisingly no such services are extended because of lack of facilities and trained manpower. Senior technical posts in the fisheries sector are being held by Indian Administrative Service (IAS) personnel without having any background and knowledge of the discipline. In fact many such posts have been encadered into the IAS and it is now virtually impossible for any technical personnel even to be considered for such posting.

Limited opportunities for training of FFDA, BFDA and State Fisheries personnel indicate that the importance of training is yet to be realized. Most of the extension staff had their training at their entry level and since then there had been no opportunity to undergo even for a short term refresher course. Even the trainers of the State run training institutions had their training at the initial phase of their service career. For providing training to the beneficiaries under FFDA and BFDA, training targets are fixed in terms of number and as such training is treated as an exercise in filling this number rather than updating the training content. In other words, all the existing training courses are run for certification and promotion rather than upgrading the knowledge and skill. Training need assessment, impact of training, improving communication skill, exposure to extension teaching methods and tools etc. are of least considerations. The existing training institutions have inadequate facilities in terms of both logistic provisions and faculty personnel. Moreover, most training programmes cover only the technological aspects while the subject of transfer of technology remain either untouched or inadequately covered. Extension personnel and aquaculture development officials have virtually no easy access to literature on the latest technologies and methodologies.

Research and extension linking mechanism is established mainly through training of extension personnel at research institutes and interaction between senior officials of the State Fisheries Departments/Fisheries Division of GOI and research managers of fisheries research institutions through formal meetings. The grass root level workers and junior officers do not get opportunity to interact with the scientists working in the field. Moreover, all such senior officers who frequently attend meetings, seminars, workshops on behalf of their organizations hardly make any effort to share their experience or exposure with junior officers and field level workers of their own organization. No system has been developed to facilitate two way flow of information between the top officials of the departments who frequently get exposed to research and development information and the grass root level extension and field personnel.

Monitoring mechanism is also weak and restricted to compilation of data in terms of coverage of water areas, average production rate, and number of people trained etc. Little or virtually no coverage is given to know-how of the technology package, level of adoption, field problems etc. Reporting is also very poor. Inspite of fixed schedule for sending reports, in most cases it is delayed. The available manpower in the Fisheries Division is not sufficient and they are not equipped to monitor the nation-wide programme of FFDA and BFDA. So far, no attempt has been made to introduce MIS system in the monitoring cell through the development and use of suitable software for project monitoring and evaluation.

Other constraints are related to interdepartmental functional relationships. Responsibility for the transfer of technology lies with the State Departments of Fisheries while the water bodies are vested to other departments/local organizations and there is no synchronization between the two. In some States like Bihar, although the water bodies have now been transferred to the Fisheries Department, the District Collector is empowered to give long term lease on the recommendation of the Department. However, under this arrangement it takes about an year or more to finalize the cases of lease settlement.

Most developmental schemes of the Government are based on liberal subsidies and concessional loans. Besides being a strain on government resources, these schemes are proving to be counterproductive. Subsidies might be justified as an incentive to adoption of new strategies, but should be withdrawn as soon as the new strategies gain popularity

and then the normal economic forces should be allowed to play their part. It is better to give a capital subsidy rather than the Government watching over the recovery of concessional loans.

Potential

So far the potential is concerned, aquaculture offers great potential in generating employment, and in increasing protein supply, income, and foreign exchange earning. The area is labour intensive. It gives direct employment to the extent of 158 days/ha/yr. Production potential is to the tune of 10 ton/ha/yr in freshwater and about 5 ton/ha/yr in brackishwater against the existing average production level of about 2 ton/ha/yr and 0.6 ton/ha/yr respectively. It clearly indicates that even without expanding the area of operation multifold production increase is possible through strengthening of the aquaculture extension services. FFDA and BFDA approach should be more production oriented, and they should be fully equipped with technical facilities and trained extension manpower. It is also necessary to create an "All India Service" in Fisheries, with benefits comparable to other All India Services.

Efforts should be directed towards raising average yield rate with the introduction of improved production technologies and judicious use of material inputs through vigorous and aggressive extension services. Horizontal expansion can also be achieved at the same time by promoting farmer to farmer approach or Trickle Down Extension Approach (TDEA).

Availability of quality fish seed of desired size and quantity is the major limitation. It would be wise to promote at least 5 to 10 per cent of the fish farmers of a given locality as fish seed farmers. It will help in meeting the demand of seed and the fish seed farmers will also get higher return on their investment. This will also encourage the practices of multiple stocking and harvesting, thereby further increasing the production potential. However, the supply of spawn will have to come from hatcheries owned and managed by the government or entrepreneurs in the private sector.

The concept of **aquaculture estates** is of recent origin. Identification of low lying areas, swamps, inundated fallow areas along the irrigation canals; development of such areas into grow-out ponds; provision of infrastructural facilities such as hatchery, nursery and rearing ponds, ice plant and training centre; and leasing out one pond to one individual fishermen /pondless farm families are the functional component of this recent concept. Initially, the Aquaculture Estate development is carried out by the State as it involves huge investment, but gradually the management of the entire estate is transferred to the organization of the lease holders who also undertake the responsibility for the recovery of loans. Such a complex has been established at Sultanpur in UP and is running successfully (Dehadrai - personal communication).

To achieve the full potential of aquaculture a Three Directional Approach - (i) creating basic infrastructural facilities and support services; (ii) development of appropriate culture technology packages; and (iii) ensuring quick delivery of the same through aquaculture extension personnel - is needed. Technical competence, professionalism and technology transfer skill should form the backbone of an efficient Aquaculture Extension Service.

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TABLE - 1 A

FISH PRODUCTION IN INDIA
(Million tonnes)

Year	*Marine*	*Inland*	*Total*
1950-51	0.534	0.218	0.752
1960-61	0.88	0.28	1.16
1970-71	1.086	0.67	1.756
1980-81	1.555	0.887	2.442
1984-85	1.698	1.103	2.801
1985-86	1.716	1.16	2.876
1986-87	1.713	1.229	2.942
1987-88	1.658	1.301	2.959
1988-89	1.817	1.335	3.152
1989-90	2.275	1.402	3.677
1990-91	2.3	1.536	3.836
1991-92	2.447	1.71	4.157
1992-93	2.576	1.789	4.365

Source : DAC , GOI.

TABLE -1B

STATE WISE FISH PRODUCTION
1992-93 (Provisional)

Production in .000 tonnes

Sl.No.	*States / UT's*	*Marine*	*Inland*	*Total*
1	Andhra Pradesh	113.07	151.48	264.55
2	Arunachal Pradesh		1.6	1.6
3	Assam		140	140
4	Bihar		164.07	164.07
5	Goa	101.49	2.77	104.26
6	Gujarat	589	49	638
7	Haryana		20.15	20.15
8	Himachal Pradesh		6.39	6.39
9	Jammu & Kashmir		14.3	14.3
10	Karnataka	174.19	65.7	239.89
11	Kerala	496.24	38.16	534.4
12	Madhya Pradesh		55.71	55.71
13	Maharashtra	387.55	77.19	464.74
14	Manipur		11.2	11.2
15	Meghalaya		3.56	3.56
16	Mizoram		3.38	3.38
17	Nagaland		1.5	1.5
18	Orissa	119.38	93.76	213.14
19	Punjab		16	16
20	Rajasthan		10.92	10.92
21	Sikkim		0.09	0.09
22	Tamil Nadu	308	98	406
23	Tripura		23.37	23.37
24	Uttar Pradesh		121.43	121.43
25	West Bengal	145	612	757
26	Andaman & Nicobar	24.17	0.1	24.27
27	Chandigarh		0.05	0.05
28	Dadra & Nagar Haveli		0.02	0.02
29	Daman & Diu	13.43		13.43
30	Delhi		3.6	3.6
31	Lakshadweep	9.73		9.73
32	Pondichery	35	3.55	38.55
33	Deep Sea Vessels	60		60
	Total	**2576.25**	**1789.05**	**4365.3**

Source : DAC, GOI

TABLE - 2

EXPORT OF MARINE PRODUCTS
QUANTITY EXPORT AND FOREIGN EXCHANGE EARNED

Year	*Quantity (ton)*	*Value (Million Rs.)*
1961-62	15,732	39.2
1971-72	35,523	445.5
1981-82	70,105	2860.1
1982-83	78,175	3613.6
1983-84	92,691	3730.2
1984-85	86,187	3812.9
1985-86	83,651	3890
1986-87	85,843	4606.7
1987-88	97,179	5312
1988-89	99,777	5978.5
1989-90	1,10,843	6349.9
1990-91	1,39,419	8933.7
1991-92	1,71,820	13758.9
1992-93	2,08,602	17674.3

Source : Joseph , DAC , GOI.

TABLE - 3

FISHERY RESOURCES AND ESTIMATED ANNUAL PRODUCTION POTENTIAL

Sl.No	*Fisheries Resources*		*Estimated Production Potential (Million ton)*
1	**Marine Fishery Resources**		From area within 50 m. depth - 2.21
	i Length of coast line	8085 kms.	From area beyond 50 m. depth- 1.69
	ii Continental shelf	0.512 million sq. kms.	
	iii Exclusive Economic zone (EEZ)	2.02 million sq.kms.	TOTAL - 3.9
2	**Inland Fishery Resources**		
	i River and canals	0.164 million kms.	0.04
	ii Reservoirs	1.973 million ha.	0.19
	iii Tank and ponds	2.212 million ha.	3.3
	iv Beels, ox-bow lakes, derelict water bodies ,etc.	1.296 million ha.	0.13
			0.84
	v Brackishwater area	1.412 million ha.	TOTAL - 4.5
TOTAL ESTIMATED PRODUCTION POTENTIAL —			**8.40 million tonnes**

Source : DAC , GOI. and Sampath (personal communication)

TABLE - 4

FISH SEED PRODUCTION

YEAR	Million fry
1973 - 74 (End of IV th Plan)	409
1978 - 79 (End of V th Plan)	912
1984 - 85 (End of VI th Plan)	5639
VII th Plan	
1985 - 86	6322
1986 - 87	7601
1987 - 88	8608
1988 - 89	9325
1989 - 90	9691
Annual Plan	
1990 -91	10332
1991 -92	12203
1992 -93	12500

SOURCE : State / UT GOVTS. DAC . GOI .

TABLE - 5

STATEWISE DETAILS OF SHRIMP FARMING (1992 -93)

State	*Estimated brackishwater area (ha)*	*Area under culture (ha)*	*Estimated production (ton)*
West Bengal	4,05,000	34,050	16,300
Orissa	31,600	7,760	4,300
Andhra Pradesh	1,50,000	9,500	12,800
Tamilnadu	56,000	530	1,100
Pondicherry	800	Negligible	Negligible
Kerala	65,000	13,400	9,750
Karnataka	8,000	2,570	1,150
Goa	18,500	550	350
Maharashtra	80,000	1,980	1,050
Gujarat	3,76,000	360	200*
Total	**11,90,900**	**70,700**	**47,000***

* Apart from this, 3,900 tonnes of freshwater prawns are produced from the farms in Gujarat taking the total production from culture source to about 51,000 tonnes.

Source : MPEDA. (*Aquaculture for farmers, Aug. 1993*)

TABLE - 6

SHRIMP CULTURE PRACTICE IN INDIA

Sl.No.	*Culturable area and farming practice*	*Estimated production rate (ton/ha./yr)*	*Area Coverage (ha.)*
* 1	Potential area available for shrimp culture	-	1.2 million
2	Area under shrimp cultivation	-	70,700
3	Traditional (extensive) practice	0.5 -0.6	52,500
4	Semi - intensive practice	3 - 4	14,000
5	Intensive farming	8 - 10	3,500

* As per the estimate by CICEF it could go up to 225,000 ha.

SOURCE : MPEDA / Sampath (1993).

TABLE - 7

SHRIMP HATCHERIES IN INDIA

Sl.No	Name	Projected capacity (million)	Owned by	Species of seed Produced
1	The Orissa Shrimp Seed Production Supply and Reserarch Centre, Orissa	25	MPEDA	Tiger
2	The Andhra Pradesh Shrimp Seed Productiion Supply and Research Centre Visakhapatnam, A.P.	80	MPEDA	Tiger
3	M/S. Thaper Water Base Ltd. Andhra Pradesh	70	Private	Tiger
4	TNFDC Prawn Hatchery Tamil Nadu	10	State Govt.	White
5	Hindustan Lever Prawn Hatchery Madras , T.N.	10	Private	Tiger
6	George Maijo Madras ,T.N.	50	Private	Tiger
7	Victory Aquafarms Tuticorin ,Kerala	40	Private	Tiger White, Flower
8	Pioneer Aquafarms Tuticorin ,Kerala	10	Private	Tiger
9	M/S MAC Industries LTD. Madras ,T.N.	200	Private	White (Hatchery under construction)
10	Modern Prawn Hatchery Madras ,T.N.	3	Private	Tiger, White ,Scampi
11	Regional Shrimp Hatchery Kerala	5	State Govt.	Tiger White , Scampi
12	Prawn Hatchery,Matsyafed Kerala	10	State Govt.	White
13	CIBA Prawn Hatchery Kerala	Experimental	ICAR	Tiger, White
14	MPEDA Prawn Hatchery Kochi ,Kerala	5 Training	MPEDA	Tiger, White
15	M/S. Royal Fresh Water Shrimp Hatchery Kochi, Kerala	1	Private	Scampi
16	Fisheries College, Kerala Agric. Univ. , Kerala	1	Agric. Univ.	Scampi
17	Prawn Hatchery Karnataka	10	State Govt.	Under Construction
18	Deejay Research & Breeding Farm Karnataka	20	Private	Tiger
19	M/S. Skyline Aqua-Ace Biotechnologies PVT.LTD. Karnataka.	200	Private	Tiger
20	Prawn Hatchery , Maharashtra.	10	State Govt.	Banana
21	Gujrat Fisheries Aquatic Science Research Institute, Gujarat.	Experimental	Govt.	Banana
22	Kumta Shrimp Hatchery ,Karnataka	10	Govt.	Tiger

Source : MPEDA / Fishing Chimes.

TABLE - 8

PROGRESS OF FISH FARMERS' DEVELOPMENT AGENCIES (FFDA)

Up to March, 1993 (cum.)

States /UTs	*No. of FFDAs*	*Water area covered (ha)*	*Fish Farmers Trained (No)*	*Average Production (Kg / ha / year)*
Andhra Pradesh	22	13022	7545	1730
Arunachal Pradesh	2	60	455	1280
Assam	23	1806	6233	1845
Bihar	49	21093	21289	1910
Goa	1			
Gujarat	17	27044	7037	1030
Haryana	16	13591	6031	3550
Himachal Pradesh	2	220	1371	2200
Jammu & Kashmir	2	1255	868	700
Karnataka	18	16325	5972	1055
Kerala	14	3338	4841	1300
Madhya Pradesh	45	45320	21129	1300
Maharashtra	29	6504	4173	500
Manipur	8	1594	2405	1500
Meghalaya	1	25	40	700
Mizoram	3	67	108	2000
Nagaland	3	1138	999	550
Orissa	17	35916	32693	1850
Punjab	14	10388	16271	4080
Rajasthan	15	3529	5548	1415
Sikkim	1	36	174	700
Tamil Nadu	17	5860	6215	1130
Tripura	3	3251	16216	1825
Uttar Pradesh	56	57874	64866	1900
West Bengal	18	90063	167102	3000
Pondicherry	1	52	152	700
Total	397	359371	399729	

Source: Chauhan, DAC , GOI.

TABLE - 9

SUBSIDY PROVISION TO FISH FARMERS UNDER FFDA PROGRAMME

Sl.No.	*Item*	*Rate of subsidy*	*Maximum Ceiling Amount (Rs)*
1	Construction of new ponds	20%	20,000/ ha
2	Renovation / reclamation of ponds	25%	8,000/ha
3	Material inputs required for first year of culture operation (seed , feed , manure etc.)	25%	4,000/ha
4	Construction of running water aquaculture unit of 1500 sq. ft. with 3 ft. depth each	25%	2,000/unit
5	Aerator	25%	10,000 / unit for those farmers who venture for intensification of aquaculture after achieving yield @ 3 ton / ha / year
6	Integrated fish farming with piggery / poultry /duckery etc.	25%	10,000/ha
7	Freshwater prawn / fish hatchery with capacity 5-10 million seed / yr	Fixed	50,000/-

The rate of subsidy is double for the farmers belonging to Scheduled Tribe (ST))category

Source : DAC ,GOI

TABLE - 10

PROGRESS OF INTEGRATED BRACKISHWATER FISH FARMERS' DEVELOPMENT AGENCIES UP TO SEPT., 1993 (Cum.)

Sl.No	*State / UT.*	*Area Brought under Culture / Development (ha.)*	*Farmers Trained (No.)*	*Beneficiaries (No.)*
1	A & N. (Union Territory)			
2	Andhra Pradesh	260		299
3	Gujrat	304	158	483
4	Goa	44		
5	Karnataka	33	400	
6	Kerala	442	729	239
7	Maharashtra	7		
8	Orissa	9652	2538	7188
9	Tamil Nadu	109.32	56	215
10	West Bengal	728	4006	1084
	Total	**11579.32**	**7887**	**9508**

Source : Sampath, 1993.

TABLE - 11

PROVISION OF SUBSIDY UNDER BFDA PROGRAMME FOR EXTENSIVE / SEMI - INTENSIVE SHRIMP CULTURE

Sl.No	*Item .*	*Rate of subsidy*	*Maximum permissible amount (Rs)*
1	Capital cost on pond development and cost of inputs for first crop	25%	30,000 / ha (Maximum holding size - 10 ha)
2	Small scale / backyard shrimp hatchery with 2-5 million seed production capacity / annum	Fixed	100,000 / Unit

Source : DAC.GOI

TABLE-12

AQUACULTURE EXTENSION PROGRAMME IN INDIA

S.No.	Organization	Programme	Operational design
1	**Fisheries Division,** Ministry of Agriculture & Cooperation, GOI. and **State / Uts Departments of Fisheries**	FFDA (Freshwater aquaculture) and BFDA (Brackishwater aquaculture)	• Mobilizing water area on lease • Technical advice • Assistance in mobilizing institutional credit • Subsidy assistance • Seed supply on cost basis • Method and result demonstrations • Training • Field days • Distribution of printed materials
2	**Indian Council of Agricultural Research (I C A R)**	**KVK / TTC / ORP / NDP /AICRP / LLP TBASP and other TOT programmes conducted by Institutes / SAUs**	• Method and result demonstrations • Farming system research trials • Limited input assistance under certain programmes • Training to fish farmers • Training to fisheries operatives • Training to extension and field workers • Technical advice • Solutions to field problems
3	**MPEDA** Ministry of Commerce, **G O I**	**Export promotion** Brackishwater shrimp and freshwater prawn culture	• Technical advice • Subsidy assistance • Training to entrepreneur and farmer • Assistance in marketing and exports • Assistance in export duty reduction • Assistance in project preparation and mobilizing institutional finance • Distribution of printed materials
4	**DBT**	**R & D efforts to improve the technology package and pilot scale demonstration**	• Demonstration at pilot scale • Training to entrepreneurs, farmers and fisheries officers • Support in preparation of printed materials and distribution
5	**NGOs / CAPART**	**Integrated rural development**	• Organizing rural poor • Mobilizing public water bodies on lease • Input assistance • Training • Credit • Group savings

TABLE - 13

SUBSIDY PATTERN - MPEDA

Sl. No.	*Item*	*Extent of Subsidy*	*Maximum permissible amount (Rs.)*
1	New farm development / Capital investment. (for brackishwater shrimp and freshwater prawn)	25%	30,000/ha and maximum up to 0.15 million for developing a maximum of 10 ha.
2	Shrimp hatchery (30 million seed / annum capacity)	Fixed	0.5 million against the capital investment of Rs.3 to 3.5 million.
3	Shrimp seed	Fixed	Rs 450/- ha
4	Shrimp feed	Fixed	Rs.3000/- ha
5	Insulated boxes	25%	Rs.307/- box with a maximum of 4 boxes.

Subsidy is given to any individual / unit at this rate upto a maximum area of 50 ha.

Source : MPEDA

TABLE - 14 A

Operational inputs, yield cost, and income from composite fish culture operations of high level of input technology at 1989 price level.

Item	*Qty / ha*	*Cost / ha (Rs.)*
Fingerlings	10,000 nos.	4,950
Mahua oil cake @ Rs 2.50/kg.	2,000 kg	5,000
Lime @ Rs 1.50/kg	500 kg	750
Organic fertilizer	6000 kg	900
Chemical fertilizer	500 kg.	1,400
Feed	19000 kg	47,500
Weeds (collection charges @ Rs. 25/ ton)	120 ton	3,000
Wages @ Rs. 600 / month for two persons		7,200
Depreciation of nets (three-year life)		3,333
Pond maintenance		1,000
Miscellaneous operational costs		2,000
Interest on operating capital @ 18% half yearly		6,820
TOTAL		**83,853** **Say Rs. 84,000.**

Total cost = fixed costs + operating cost = Rs 26,000 + Rs 84,000 = Rs.1,10,000
Average gross yield = 9,500 kg / ha / yr
Gross income @ Rs.20 / kg = Rs 1,90,000
(at a lower level of farm gate, even though they are sold at an average of
Rs 25-30 in consumer markets)
Net profit = Rs 1,90,000 - Rs 1,10,000 =Rs 80,000

Source : M.Randhir,1989

TABLE - 14 B

Operational inputs, yield cost,and income from composite fish culture operations of intermediate level of input technology at current prices (level - I)

Item	*Qty / ha.*	*Cost / ha (Rs.)*
Fingerlings 3,500 Indian carps & common carp @ Rs 250/1,000 nos. 2,500 exotic carps @ Rs 600/1,000 nos.	6,000 nos.	2,375
Mahua oil cake @ Rs 2.50/kg (piscicide)	2,000kg	5,000
Lime @ Rs1.50 / kg	500kg	750
Cow dung @ Rs.150 / ton.	10 ton	1,500
Urea @ Rs 2.50 / kg	150 kg	375
Single superphosphate @ Rs 1.00 / kg	350 kg	350
Muriate of potash @ Rs 2.00/ kg	50 kg	100
Ammonium sulphate @ Rs 2.50 /kg.	200 kg	500
Groundnut /mustard oil cake @ Rs 3.50/ kg	5,000 kg	17,500
Rice bran @ Rs 1.50/ kg	5,000 kg	7,500
Weeds (collection charges @Rs 25/ ton)	100 ton	2,500
Wages @ Rs 600/ month for 2 persons		7,200
Depreciation of nets (three year life)		3,333
Pond maintenance		1,000
Miscellaneous operational costs		2,000
Interest on operating captial @18% half-yearly		4,673
TOTAL		56,661 Say 57,000

Total cost = Rs 26,000 + 57,000=Rs 83, 000
Average gross yield = 6000kg
Gross income @ Rs 20/kg = Rs 1,20,000
(at a lower level of farm gate price, even though they are sold at an average of Rs 25 - 30 /kg in consumer markets)
Net profit = Rs 1,20,000 - Rs 57,000 =Rs. 63,000

Source : Randhir (1989).

TABLE 14 C

Operational inputs, yield cost, and income from composite fish culture operations of intermediate level of input technology at current price (level - II)

Item	*Qty / ha*	*Cost / ha (Rs.)*
Fingerlings Indian carps & common carp @Rs250/1,000 3,500: 2,500 exotic carps @Rs 600/1,000 nos.	6,000 nos.	2,375
Mahua oil cake @ Rs 2.50 / kg	2000 kg	5,000
Lime @ Rs 1.50 /kg	500 kg	750
Cowdung @ Rs150/ ton	10 ton	1,500
Phosphate / nitrogen fertilizer	500 kg	1,000
Weeds (collection charges @ Rs 25/ ton)	100 ton	2,500
Wages @ Rs 600 /month for 2 persons		7,200
Rental for nets		2,000
Pond maintenance		1,000
Miscellaneous operational costs		2,000
Interest on operating captial @ 18%half yearly		2,279
Total		27,604 Say 28,000

Total cost = pond rental + operating cost = Rs 10,000+ Rs 28,000 = Rs 38,000
Average gross yield = 3000 kg
Gross income @ Rs 20/ kg = Rs 60,000
(at a lower level of farm gate price, even though they are sold at an average of Rs 25 -30 / kg in consumer markets)
Net profit = Rs 60,000 -38,000 = Rs 22,000

Source : Ranadhir (1989)

	TABLE 15 - A
ECONOMICS OF EXTENSIVE FARMING (TIGER SHRIMP)	
I ASSUMPTIONS	
a. Farm size (water spread area)	5 ha.
b. Culture period	4 to 4 and a half month
c. Stocking rate	50,000 nos/ha
d. Survival rate	70%
e. Average shrimp weight at harvest	30 gms.
f. Average yield	1000 kg / ha / crop
g. Feed conversion ratio	2.5:1(with feed costing Rs.12/-per kg
h. Pond size	1ha (5 no.)
II DEVELOPMENT COST ESTIMATE (5 ha. water area)	
	(Rs.)
a. Earth work (15000 m3)	300,000
b. Stone pitching on one of the four sides	30,000
c. Main outlet (1 no) for drainage,canal	20,000
d. Individual pond inlets (5 nos)	10,000
e. Sluice gate for each pond (outlets 5 nos.)	40,000
f. Pump (10 HP x4 Nos. inculding one 10 HP standby diesel pump)	85,000
g. Pump house cum shed	40,000
h. Store cum office	60,000
i. Miscellaneous	10,000
Total	595,000
Development cost per ha = Rs. 119,000	
III OPERATIONAL COST FOR ONE CROP (5 HA. WATER AREA)	
	(Rs.)
a. Seed (2.5 lakhs @ Rs. 200/ 1000nos)	50,000
b. Feed (12500 kg @ Rs.12/-per kg)	150,000

c. Fertilizers and manures for pond preparation	15,000
d. Staff salary (one farm supervisor @ Rs. 1500/- per month. One Watchman @ Rs. 600 per month and two labourers @ Rs. 600 per month	20,000
e. Fuel & electricity	40,000
f. Harvest	5000
g. Miscellaneous expenses	20,000
Total	**300,000**

Operational cost per year for two crops = Rs. 600,000
Production cost per kg = Rs. 3,00,000

5,000 kg — Rs. 60.00 /

IV GROSS INCOME FROM SALES

	(Rs.)
a. From one crop for 5 ha .(5000 kgs x Rs. 120/-)	600,000
b. per year	1,200,000
c. From one crop per ha	120,000
d. Per year per ha	240,000

V ECONOMICS AND REPAYMENT

A. Total investment	Cost of development + operational cost of 1st crop = Rs. 595,000+Rs.300,000lakhs
B. Gross profit before interest and repayment	Gross income per year - (operational cost for one year + depreciation @ 10 % of cost of development) Rs.12,00,000 - (600,000 +60,000) =Rs.5,40,000

	TABLE 15- B
ECONOMICS OF SEMI-INTENSIVE FARMING (Tiger shrimp)	
I ASSUMPTIONS	
a. Farm size (water area)	5 ha
b. Pond size	0.5 ha (10 nos.)
c. Culture period	4 to 4 1/2 months
d. Stocking rate	0.3 million / ha
e. Survival rate	70%
f. Average shrimp size at harvest	25 gm
g. Average yield	5000 kg/ ha/ crop.
h. Feed conversion ratio	1.5:1 (with formulated pelletised feed costing Rs.30/- per kg).
II DEVELOPMENT COST (5 ha. water area)	
	(Rs.)
a. Earth work for construction of ponds drainge & feeder canals etc. (20000 cu. m.)	400,000
b. Lining of feeder canal	70,000
c. Water inlet structures for ponds (20 nos.)	50,000
d. Water outlet structures for ponds (10 nos.)	100,000
e. Main outlet sluices (2 nos.)	30,000
f. Pump house, generator shed cum work shop and diffuser tank etc.	150,000
g. Office, laboratory, dormitory and store	300,000
h. Watchman shed (2 nos.)	20,000
i Drinking water storage and supply network including installation of borewell.	75,000
j. Pumps (3 no. mixed flow pump,each 25 HP)	255,000
k. Aerators (30 nos. 1 HP each)	600,000
l. Electrical installationsand electrification	200,000
m. generators (2 nos. x30 KVA)	350,000

n. Lab and farm equipment	100,000
o. Miscellaneous expenditure	50,000
Total	2,750,000
Development cost per ha.= Rs. 550,000	
III OPERATIONAL COST FOR ONE CROP (5 ha. water area)	
	(Rs.)
a. Seed (@ Rs. 200 / 1000 nos. for 1.5 million)	300,000
b. Feed (@ Rs. 30 kg for for 37,500kgs.)	1,125,000
c. Chemicals and manures for pond preparation (@ Rs. 15000/-per ha)	75,000
d. Fuel and electricty	150,000
e. Annual maintenance repairs	70,000
f. Harvesting	50,000
g. Labour (for pond preparation, stocking etc.)	20,000
h. Staff salary (One farm Manager @ Rs. 2500/- per month one mechanic @ Rs. 1200/- per month two farm hands @ Rs. 600/- per month two watchmen @ Rs. 600/- per month)	37,000
i) Office expenses and other miscellaneous expenses	50,000
Total	1,877,000
Operational cost per year for two crops	3,754,000
Production cost per kg. = Rs. (18,77,000) / (25,000) = Rs. 75.08	
IV. GROSS INCOME FROM SALES	
	(Rs.)
a. From one crop (25,000kg x Rs.110)	2,750,000
b. Per year	5,500,000
c. Per ha. per crop	550,000
d. Per ha. per year	1,100,000
V. ECONOMICS AND REPAYMENT	

A. Total investment	Cost of development + operational cost for 1st crop = Rs.2755,000 + Rs. 1877,000 = Rs. 4632,000
B. Gross profit before interest and repayment	Gross yearly income - (operational cost of one year + depreciation @ 10% of the development cost) = Rs. 5500,000 - (Rs. 3754,000 + Rs. 276000) = Rs.1470,000
Source : MPEDA	

TABLE - 16 A-I

MODEL ECONOMICS ONE HA. FRESHWATER POND

(Figures in Rupees

Sl.No.	Gross Benifits	Operating Cost	Net Benifits
I	18000	6275	11725
II	72000	11470	60530
III	125000	20580	104420

Source : Srivastava , 1992.

TABLE - 16 A-II

BREAK UP OF OPERATING COST

PARTICULARS	COST ESTIMATE		
	I Rs.	II Rs.	III Rs.
Seed	1250	1250	1250
Organic Manures	250	500	1000
Feed	1600	3200	6400
Fertilizer	1125	2250	4500
Lease charge	250	250	250
Interest on wkg. capital	240	360	480
Marketing cost	360	2160	5000
Labour charges	1200	1500	1700
Total	**6275**	**11470**	**20580**

Source : Srivastava (1992)

TABLE - 16 B-I

MODEL ECONOMICS OF ONE HA. BRACKISHWATER POND FROM FARMER'S POINT OF VIEW

(Figures in

	Pond under p.monodon			Pond under p. indicus		
Sl. No.	Gross Benifits	Operating Cost	Net Benefit	Gross Benefit	Operating Cost	Net Benefit
I	100000	52040	47960	90000	58750	31250
II	200000	84568	115432	180000	96300	83700
III	250000	117995	132005	225000	134750	90250

TABLE - 16 B-II

BREAK-UP OF OPERATING COST

Particulars	Pond under P.monodon			Pond under P.indicus		
	I	II	III	I	II	III
Preparation of pond	1000	1000	1000	1000	1000	1000
Cost of seed	4500	4500	4500	6000	6000	6000
Cost of Fert. & Pesticide	1200	2400	3600	1300	2600	3900
Cost of feed	24375	48750	73125	29250	58500	87750
Energy cost	2700	4050	5400	2700	4050	5400
Harvesting & Marketing	900	1800	3600	900	1800	3600
Insurance	1640	3280	4920	1500	3000	4500
Repair and maintenance	600	600	600	600	600	600
Lease Charge	9000	9000	9000	9000	9000	9000
Interest on working capital	2125	3188	4250	2500	3750	5000
Labour charges	4000	6000	8000	4000	6000	8000
Total	**52040**	**84568**	**117995**	**58750**	**96300**	**134750**

Source : Srivastava ,1992.

CHART-1

ORGANIZATION CHART OF THE FISHERIES DIVISION,

Ministry of Agriculture, Deptt. of Agriculture & Cooperation

Government of India

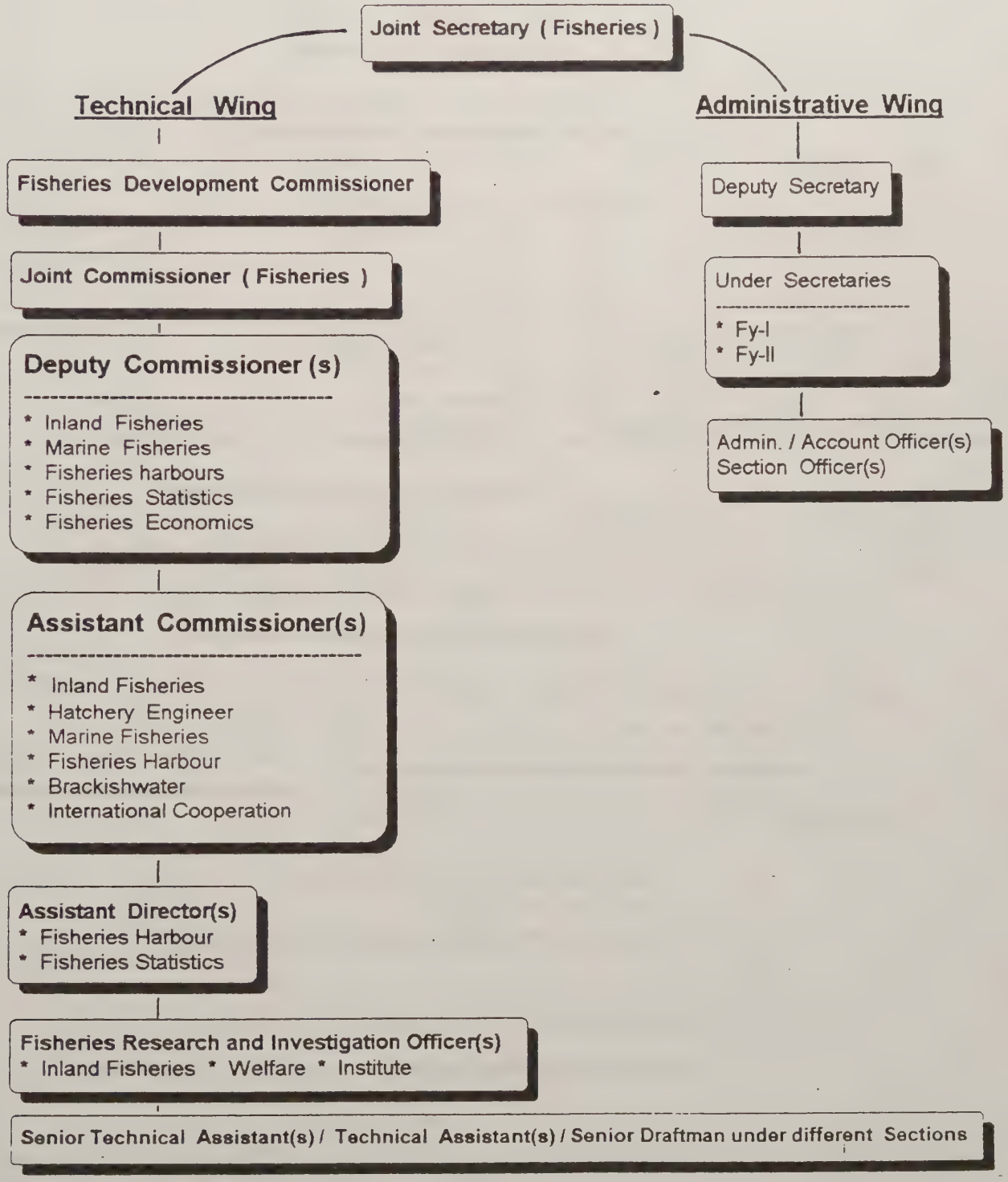
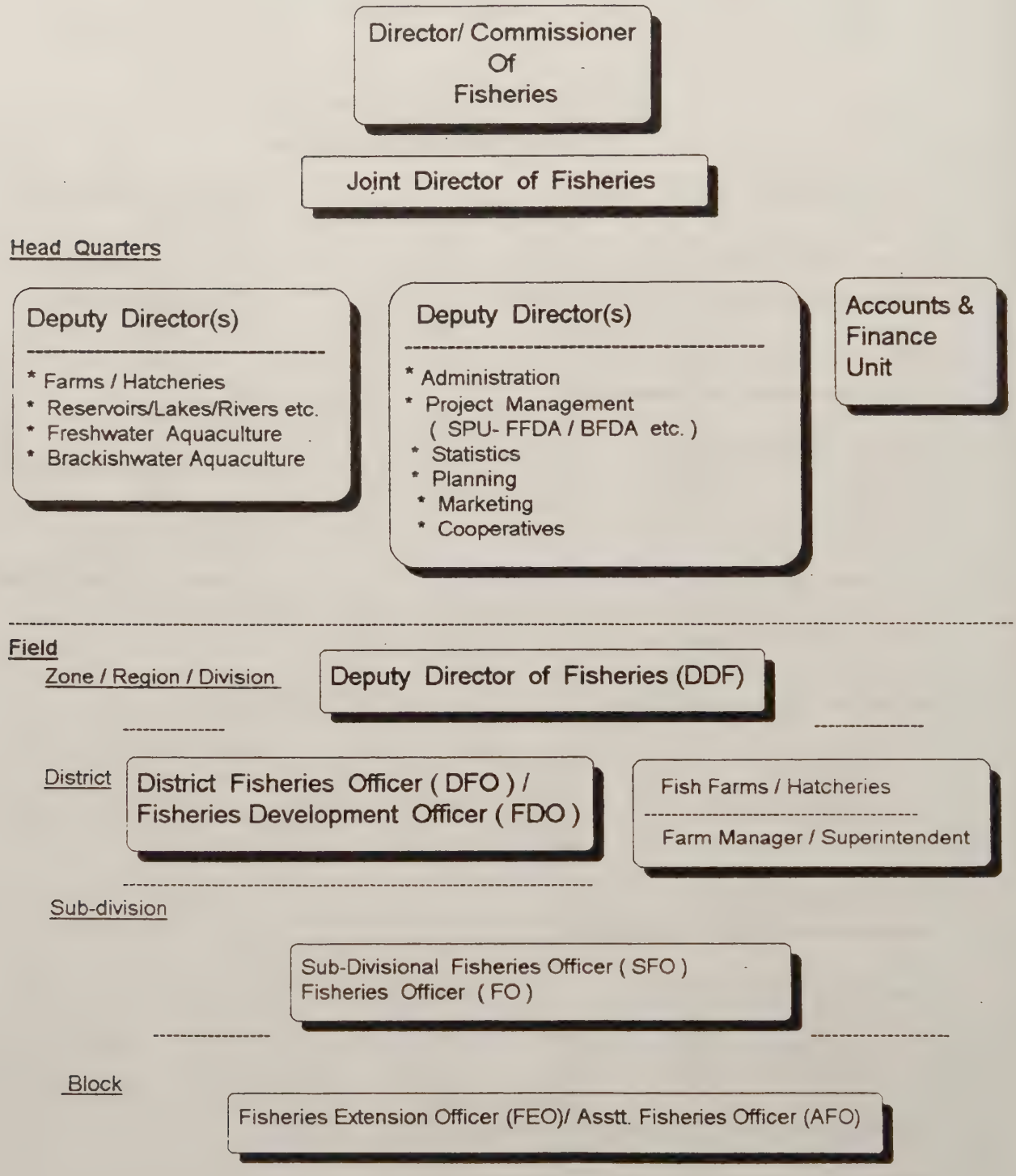


CHART-2

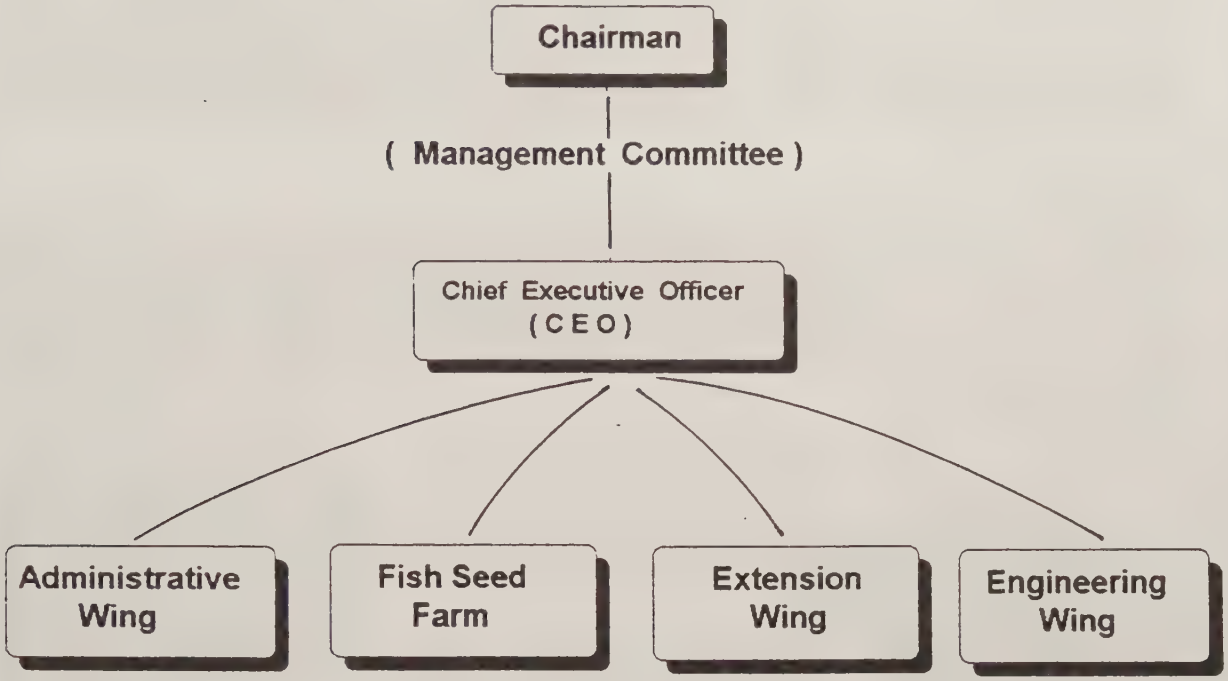
Generalized Organizational Structure of State Fisheries Directorate[1]



1/ Sub-Division and higher level offices have the provision of Office and Supporting staff. Farms, Hatcheries, Research and Field Units are provided with Field Technical Assistants.

CHART-3

Organizational Structure of Centrally sponsored FFDA Unit



Incremental Staff : Fisheries Extension Officer - 1 per 10 Extension workers
Fisheries Extension Worker - 1 per 100 ha of project pond area

CHART - 4

AQUACULTURE EXTENSION SERVICES IN INDIA

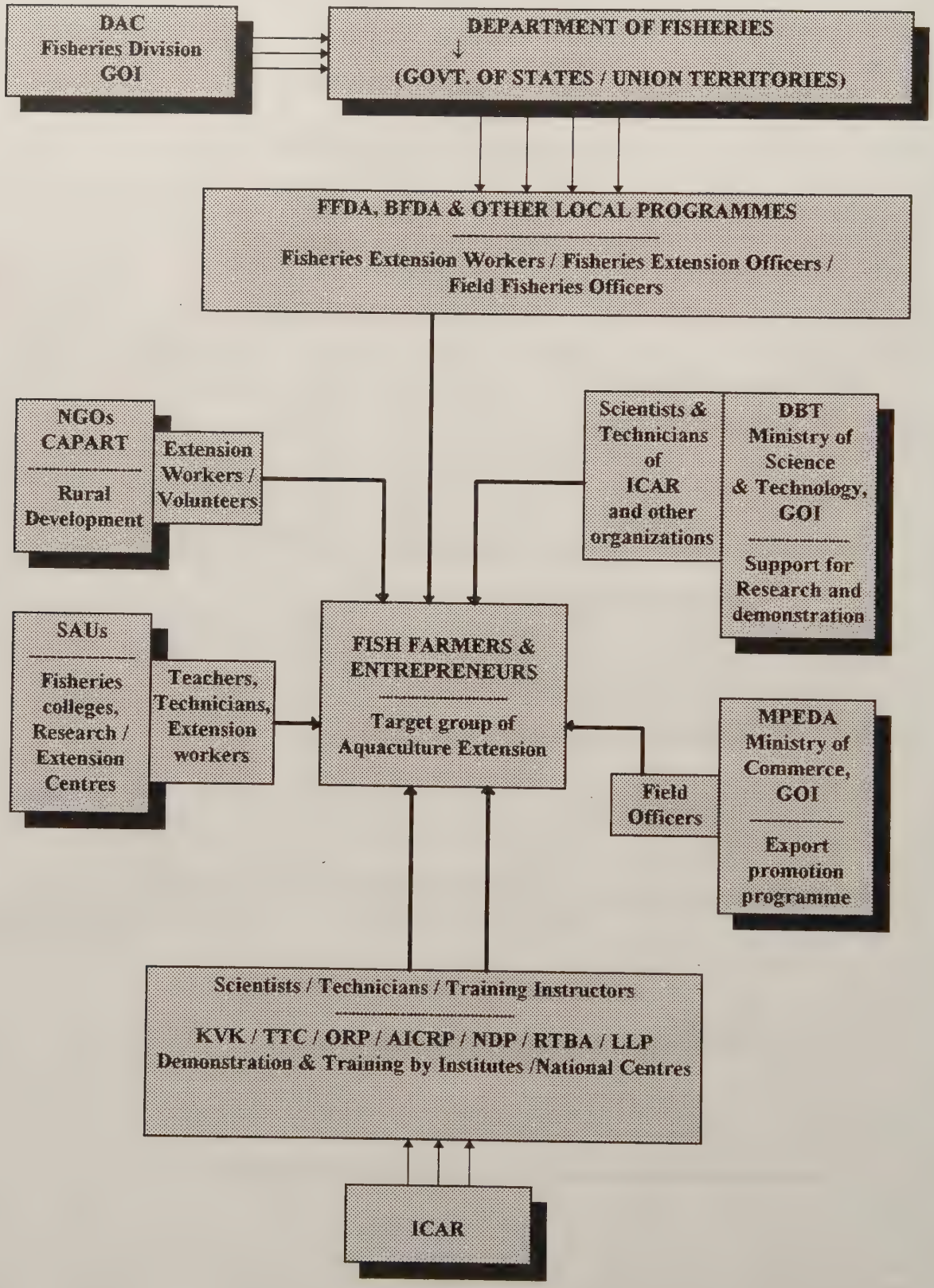
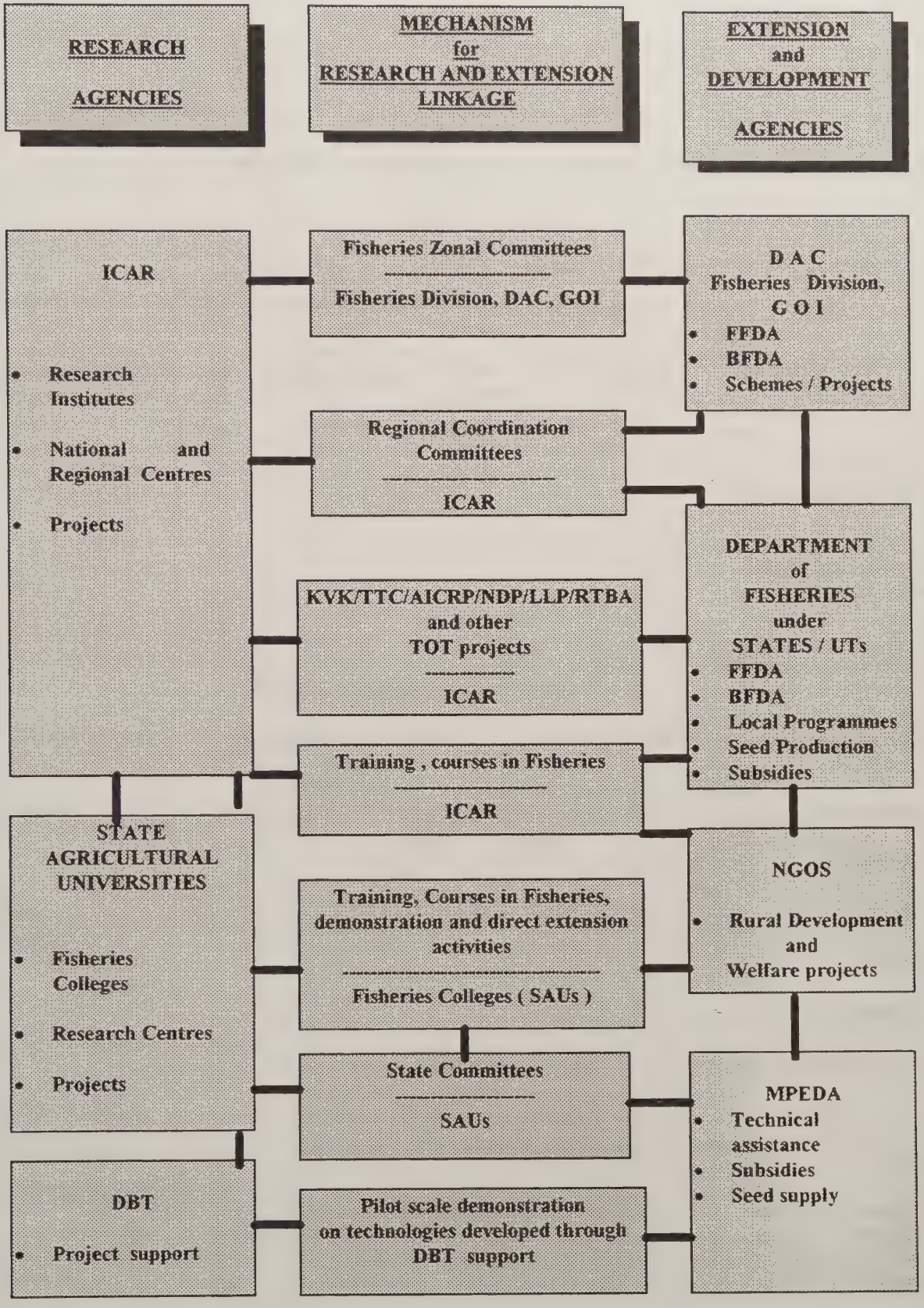


CHART-5



Aquaculture Research and Extension Linkage in India

Annexure- 1 A-1

FISH FARMERS' DEVELOPMENT AGENCY

Reporting Proforma

Qarterly / Yearly Physical Performance Report for the Quarter Ending.....

Item of work	Achievement till previous year	Target during the year	Achievement till previous quarter	Achievement during the quarter	Total achievement during the year
I. Physical performance					
a. Ponds/ tanks (ha) renovated and brought under culture during the period.					
b. New ponds constructed (ha)					
c. Running water culture (ha)					
II Fish Harvest (kg.)					
a. Above					
b. Above					
c. Above					
d. Average yield					
III No. of beneficiaries					
a. SCs					
b. STs					
c. Sts who get double benefit					
d. Others					
Total					

IV Nos. of beneficiaries trained

a. Scs.

b. Sts.

c. Others

Total

Quarterly / Yearly Financial Report For Quarter/ Year ending.....

Balance of fund as available on 1.4. 199.....		Fund released during the current year		Total fund available during the year	
GOI	STATE	GOI	STATE	GOI	STATE

FINANCIAL PERFORMANCE

Items of Expenditure	Expenditure during the Year as GOI Share		Expenditure during the Year as State Govt. Share	
Items	During the quarter	Upto the quarter	During the quarter	Upto the quarter
1. Subsidy				
a. Renovation / reclamation				
b. Input				
c. Construction of new ponds.				
d. Running water fish culture				
2. Training of farmers				
3. Incremental staff salary				
4. Cost of vehicle				
5. Other item To be fully shared by theState				

Annexure - 1 A - 2

(ADDITIONAL INFORMATION)

ANNUAL PHYSICAL PERFORMANCE REPORT OF FISH FARMERS DEVELOPMENT AGENCIES UPTO YEAR ENDING 1991 - 92 .

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1 Name of State :

2 Nos. of FFDA sanctioned :

3 Nos. of FFDA in operation :

4 Coverage of water area (ha) :

i. Since inception till previous yr :

Target :

Achievement :

ii. During the current year :

Target :

Achievement :

5 Nos. of beneficiaries

i. Since inception till previous year :

ii. During current year :

6 Nos. of beneficiaries trained :

i. Since inception till previous year :

Target :

Achievement :

ii. During current year :

Target :

Achievement :

7 Present average production (kg / ha / yr) :

8 Remarks :

ANNEXURE - 1B-1

QUARTERLY PROGRESS REPORT ENDING .....199.....
REGARDING FISH FARMERS DEVELOPMENT AGENCY .....

S.No	Particulars	Unit	Target	Achievement upto previous quarter	Achieve - ment during this	Total achie - vement
1	Identification of Water Area					
	(a) Water area surveyed	ha				
	(b) Water area leased out	ha				
2	Water area under improved fish culture.					
	(a) Area	ha				
	(b) No of fry stocked	lac				
3	Fish Seed Production					
	(a) Produced by FFDA	lac				
	(b) Procured by FFDA	lac				
	(c) Produced by farmers with minikits.	lac				
4	Fish Harvested					
	(a) From water area brought under improved fish culture	ton				
	(b) From under developed area	ton				
	(c) Total harvested	ton				
5	No.of beneficiaries (trained)					

Source : FFDA Unit Gurgaon ,Haryana .

ANNEXURE 1 B - 2

MONTHLY PROGRESS REPORT ENDING .....199....
REGARDING FISH FARMERS' DEVELOPMENT AGENCY .....

Sl. No	*Particulars*	*Unit*	*Target*	*Achievement upto previous month*	*Achievement during this month*	*Total Achiev-ement*
1	Identification of water area					
	a Water area surveyed	ha.				
	b Water area leased out	ha.				
2	Number of beneficiaries	No.				
3	Number of farmers trained					
	a. SC / ST	No.				
	b. Others	No.				
	c. Total	No.				
4	Reclamation of water area					
	a Cases submitted to banks					
	i. Number	No.				
	ii. Area	ha.				
	iii. Amount	Rs.				
	b Cases sanctioned by the banks					
	i. Number	No.				
	ii. Area	ha.				
	iii. Amount	Rs.				
5	Loan sanctioned by the banks for inputs					
	i. Number	No.				
	ii. Area	ha.				
	iii. Amount	Rs.				
6	Water area brought under improved fish culture					
	a With institutional finance	ha.				
	b Without institutional finance	ha.				
	c Total water area	ha.				
7	Fish Seed Production					
	a Produced at farm	lac.				
	b. Procured by FFDA	lac.				
	c. Produced by farmers themselves by minikits	No.				
8	Distribution of fish seed					
	a. Fish seed stocked	lac.				
	b. Area stocked	ha.				
	c. Pond stocked	No.				
9	Fish harvested / yield					
	a. Quantity harvested	ton.				
	b. Area harvested	ha.				

Origin: SPU.
Source : FFDA Unit, Gurgaon,Haryana .

Annxure - 2

PROFORMA FOR REPORTING PROGRESS UNDER THE CENTRALLY SPONSORED SCHEME "INTEGRATED BRACKISHWATER FISH FARM DEVELOPMENT"

A. BRACKISHWATER FISH FARM DEVELOPMENT State.....

1. Name of the Project / Location : (with name of district)

2. Farm area to be developed (ha) :

3. Date /Month /Year of sanction :

4. Origainal estimated cost : Rs. .....in lakh

5. Revised cost, if any : Rs. .....in lakh

6. Amount already sanctioned /released (yearwise)on each component : State share GOI share Total

7. Expenditure so far incurred (yearwise) on each comoponent : State GOI Total

8. Physical target achievement :

a. Water area so far developed : .. .. ha
(This should also include number of ponds constructed , area and other infrastructure created such as water supply systems,drainage facilities. sluice gates , buildings inlet / outlet systems, installation of water pumps, electricity ,approach road etc).
Say whether completed or not . Percentage of progress achieved and likely date of completion if not already completed.

b. Dates of completion of different items of work / farm if already completed. :

c: Water area so far leased to prawn farmers (area in ha) :

d. No.of beneficiaries :
Number of beneficiaries trained :

e. Prawn culture operation :

i Area under culture (ha) :

ii Species of prawn / fish cultured :

iii Sources of prawn / fish seed :

iv Stocking density & number of prawn / fish seed stocked (species wise) :

v Initial stocking size (mm / gm) :

vi Date of stocking :

vii Duration of culture operation. :

viii Date of harvest :

ix Average size / weight of prawn / fish harvested :

x Number of fish / prawn harvested (species wise) :

xi Rate of survival (%) :

xii Quantity of feed provided with source of supply (Kg) :

xiii Conversion value (kg of prawn vs. kg of feed given) per kg. :

xiv Quantity of prawn harvested (Kg) :

xv Average yield per ha. per crop or per annum (two crops minium) :

xvi Method of disposal of catch/ harvest (whether sold in domestic market or sold for exports) and channel of disposal (through private whole sale /retail vendors or auction or through corporation or cooperatives etc.) with quantity and value of sales: :

xvii Constraints, if any and steps taken to rectify the problems :

xviii System of monitoring the project implementation :

* From serial no. 7 quarterly report should be sent starting 1st. April onwards.

B **BRACKISHWATER FISH FARMERS' DEVELOPMENT AGENCY(BFDA)**
(Applicable to States where BFDAs are functioning)

STATE .....

1. Name of the District where BFDA is located :

2. Date of sanction of BFDA by GOI :

3. Date of Registration of BFDA by State Govt :

4. Date of provision of Staff for BFDA by the State Goverment, number of staff in position etc. :

5 Total area available in the district for brackishwater aquculture (ha) :

6. Total water area surveyed so far (ha) :

7. Physical target achievement : (to be submitted at the end of every quarter starting from 1 - 4 - 89). :

i. Targeted brackishwater area for development (50 ha per annum.)

ii Number of beneficiaries identified : 1 st qr. 2nd qr. 3rd qr. 4th qr. Total

iii Area so far settled to beneficiaries (in ha) : ... . do .. .. ..

iv. Number of beneficiaries trained so far : .. .. .. do .. ..

v. Area so far developed for prawn farming (in ha) : . . .. .. do .. .. ..

vi. Infrastructure facilities such as common water supply channel, construction of dykes, drainage facilities, inlet, outlet, water gates etc. provided with % of progress of each item.

vii. Brackishwater area so far brought under culture (year wise & quarter wise) :

viii. Species cultured (prawn /fish -specise wise) :

ix. Source of seed supply (prawn /fish-species wise) :

x Stocking density (No. per ha & total seed stocked - species wise) :

xi Date of stocking :

xii Size (length & wt) at the time of stocking (species wise) :

xiii. Duration of culture operation :

xiv. Source of supplementry feed & feeding ration :

xv. Number & wt.of prawn / fish harvested :

xvi. Rate of survival :

xvii. Average yield per ha per crop or per year in crops (minimum) 2 :

xviii. Quantity & value of prawn / fish harvested :

xix. Disposal of harvest (quantity & value of prawn / fish sold locally and / or exported :

xx. Agency involved in marketing :

xxi. Impact of the scheme on prawn farmers (income of beneficiaries before & after project) :

xxii Employment generated (in farming and other connected activities) :

xxiii. Institutional finance mobilised with name of the commercial bank :

8. Financial target & achievement : State GOI Total
quarter wise & total up to date)

a. Funds released year wise : State GOI Total.

b. Expenditure incurred (component and year wise) :

c. Subsidy given to beneficiaries year wise / : quarter wise

9. Constraints, if any, in project implementation :

10 System of monitoring progress :

D/W0503